

## **DECLARATION OF THE RECORD OF DECISION**

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### **SITE NAME AND LOCATION**

The Bremerton naval complex (BNC) is located within Kitsap County, bordering the City of Bremerton, Washington, along the north shore of Sinclair Inlet, Puget Sound. Operable Unit D (OU D) is the subject of this Record of Decision (ROD). The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number for the BNC is WA2170023418. The site is identified as the Puget Sound Naval Shipyard Complex on the National Priorities List, but the nomenclature used in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) documentation is the BNC, and that name is used herein.

### **STATEMENT OF BASIS AND PURPOSE**

This decision document presents the Selected Remedy for OU D of BNC, in Kitsap County, Washington, which was chosen in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for this site.

The remedy was selected by the U.S. Navy (Navy) and the U.S. Environmental Protection Agency (EPA). The Washington State Department of Ecology (Ecology) concurs with the Selected Remedy.

### **ASSESSMENT OF THE SITE**

The response action selected in this ROD is necessary to protect the public health or welfare and the environment from actual or threatened releases of hazardous substances into the environment. Such a release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment.

### **DESCRIPTION OF THE SELECTED REMEDY**

This ROD addresses OU D, which consists of the easternmost 2.5 acres of BNC. OU D is one of six OUs at BNC. The other five OUs are OU A, OU B Marine, OU B Terrestrial, OU Naval Supply Center (NSC), and OU C, a petroleum unit being managed under the state cleanup program. Decision documents for OU A, OU NSC, OU B Marine, and OU B Terrestrial have been completed. A steam-sparging system has been used to recover subsurface petroleum at OU C. The Navy and Ecology are evaluating potential additional remedial actions for OU C, and a Cleanup Action Plan will be prepared for the site.

The Selected Remedy for OU D was developed to address all identified risks at OU D (the site), including risks to the marine environment posed by potential movement of contaminated stormwater and groundwater into Sinclair Inlet. The major components of the Selected Remedy for OU D are the following:

- Installation of a vegetative cover or asphalt concrete pavement over the surface of all of the currently unpaved areas of OU D
- Inspection, cleaning, repair and/or replacement of significant structural damage in drain pipes, manholes, and catch basins where required and feasible
- Institutional controls to minimize human exposure to chemicals of concern in soil and groundwater
- Groundwater monitoring on a periodic basis to assess the groundwater-to-surface-water pathway

## **STATUTORY DETERMINATIONS**

The Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. The remedy in this OU does not include treatment as a principal element of the remedy for the following reasons:

- Contamination concentrations are relatively low.
- The site will be capped by pavement or covered with soil and vegetation, resulting in little potential for contact with contaminants and consequently little risk that could be addressed through treatment.
- The high costs of treatment are disproportionate to the potential benefits to be achieved.
- Contaminants are not expected to mobilize if left untreated.

The contaminated soil at OU D is not a principal threat waste as that term is defined by EPA. Principal threat wastes are source materials considered highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site above levels that preclude unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

## **DATA CERTIFICATION CHECKLIST**

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record for this site.

- Chemicals of interest (COIs) and their respective concentrations (see Section 6, Table 6-2)
- Baseline risk resulting from exposure to chemicals of potential concern (COPCs) (see Section 8)
- Cleanup levels for the chemicals of concern (COCs) (see Section 9)
- How source materials constituting principal threats are addressed (see Section 13)
- Current and reasonably anticipated future land use and exposure assumptions used in the baseline risk assessment and ROD (see Section 8)
- Potential land and groundwater use that will be available at the site as a result of the selected remedy (see Section 12.4)
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (see Section 12, Table 12-2)
- Key factor(s) that led to selecting the remedy (see Section 12.1)

Signature sheet for the BNC Operable Unit D Record of Decision among the U.S. Navy, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency.

*D. Biesel*

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D.T. Biesel  
Captain, U.S. Navy  
Commanding Officer, Naval Base Kitsap at Bremerton

*4/29/05*

\_\_\_\_\_  
Date

Signature sheet for the BNC Operable Unit D Record of Decision among the U.S. Navy, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency.



J.C. Orzalli  
Captain, U.S. Navy  
Commander, Puget Sound Naval Shipyard  
and Intermediate Maintenance Facility

4/27/05

Date

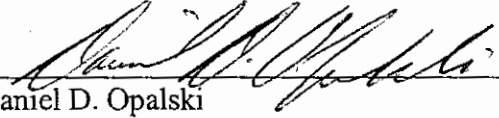
Signature sheet for the BNC Operable Unit D Record of Decision among the U.S. Navy, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency.



James J. Pendowski  
Manager, Toxics Cleanup Program  
Washington State Department of Ecology

5/3/05  
Date

Signature sheet for the BNC Operable Unit D Record of Decision among the U.S. Navy, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency.

  
\_\_\_\_\_  
Daniel D. Opalski  
Director, Environmental Cleanup Office, Region 10  
U.S. Environmental Protection Agency

5/11/05  
Date

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## ABBREVIATIONS AND ACRONYMS

ACP	asphalt cement pavement
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BNC	Bremerton naval complex
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
CIP	Community Involvement Plan
COI	chemical of interest
COC	chemical of concern
COPC	chemical of potential concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSF	cancer slope factor
CT	central tendency
Ecology	Washington State Department of Ecology
EFA NW	Engineering Field Activity, Northwest
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
FS	feasibility study
HEAST	Health Effects Assessment Summary Tables
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
IAG	Interagency Agreement
IC	institutional control
IRIS	Integrated Risk Information System
IMF	Intermediate Maintenance Facility
LUC	land use control
mg/kg	milligram per kilogram
mg/kg-day	milligram per kilogram per day
MTCA	Model Toxics Control Act
NAGPRA	Native American Graves Protection and Repatriation Act
Navy	U.S. Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System

### **ABBREVIATIONS AND ACRONYMS (Continued)**

NPL	National Priorities List
NSB	Naval Station Bremerton
NBK	Naval Base Kitsap
NSC	Naval Supply Center
O&M	operation and maintenance
OU	operable unit
OU B M	OU B Marine
OU B T	OU B Terrestrial
PCB	polychlorinated biphenyl
PCCP	Portland cement concrete paving
PCE	tetrachloroethene or perchloroethene
PRG	preliminary remediation goal
PSNS	Puget Sound Naval Shipyard
RAB	Restoration Advisory Board
RAO	remedial action objective
RBSC	risk-based screening concentration
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RfD	reference dose
RI	remedial investigation
RME	reasonable maximum exposure
ROD	record of decision
SARA	Superfund Amendments and Reauthorization Act
SI	site inspection
SVOC	semivolatile organic compound
TAPP	Technical Assistance for Public Participation
TEF	toxicity equivalency factor
TPH	total petroleum hydrocarbons
TRC	Technical Review Committee
TTEC	total toxicity equivalent concentration
UCL95	95 percent upper confidence limit
VOC	volatile organic compound
WAC	Washington Administrative Code

## **DECISION SUMMARY**

### **1.0 INTRODUCTION**

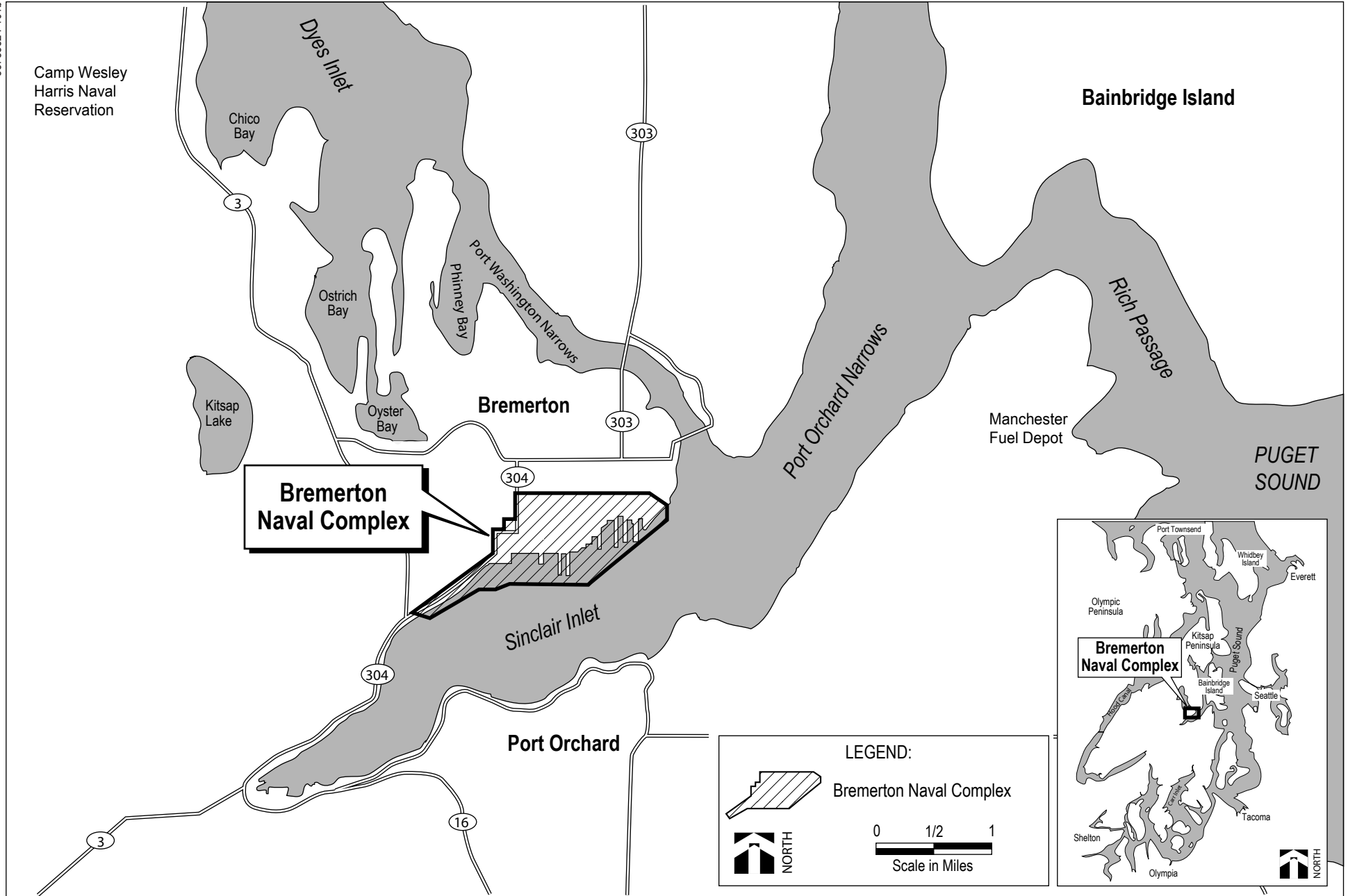
The U.S. Navy (Navy), in cooperation with the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology), is carrying out remedial actions at the Bremerton naval complex (BNC) in Bremerton, Washington (Figure 1-1). This Record of Decision (ROD) presents the remedial actions selected to address environmental contamination at Operable Unit (OU) D at BNC. The Navy is the lead agency for this decision document, and this ROD reflects EPA and Ecology concurrence with the selected remedial actions. The remedial actions are also considered responsive to public concerns expressed in the community participation process for this facility.

These actions are being performed by the Navy under the Installation Restoration Program in accordance with the Executive Order 12580 delegation of responsibility and authority for implementation of the 1980 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. These remedial actions comply with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR 300. The Navy's actions are also guided by Washington State regulations, including the Washington State Model Toxics Control Act (MTCA, Revised Code of Washington [RCW] 70.105D), and state cleanup regulations (Washington Administrative Code [WAC] Chapter 173-340).

BNC was assigned Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) number WA2170023418 and added to the National Priorities List (NPL) on May 31, 1994. The Navy is the lead agency for this work and is performing the work under the Installation Restoration Program, established to address environmental contamination from past operations and waste disposal practices. The Navy's Engineering Field Activity, Northwest (EFA NW) is responsible for the programmatic activities related to cleanup of historical contamination at BNC. On August 31, 1998, the Navy entered into an Interagency Agreement (IAG) with Ecology and EPA to establish a framework for conducting investigation and cleanup actions at BNC under CERCLA and MTCA. The Navy is responsible for all aspects of the cleanup of historical contamination at BNC.

OU D is one of six operable units at BNC, as shown in Figure 1-2. Five OUs are CERCLA units: OU A, OU B Marine (OU B M), OU B Terrestrial (OU B T), OU Naval Supply Center (NSC), and OU D. OU C is a petroleum unit being managed under the state cleanup program. Decision documents for OU A, OU NSC, OU B M, and OU B T have been completed.

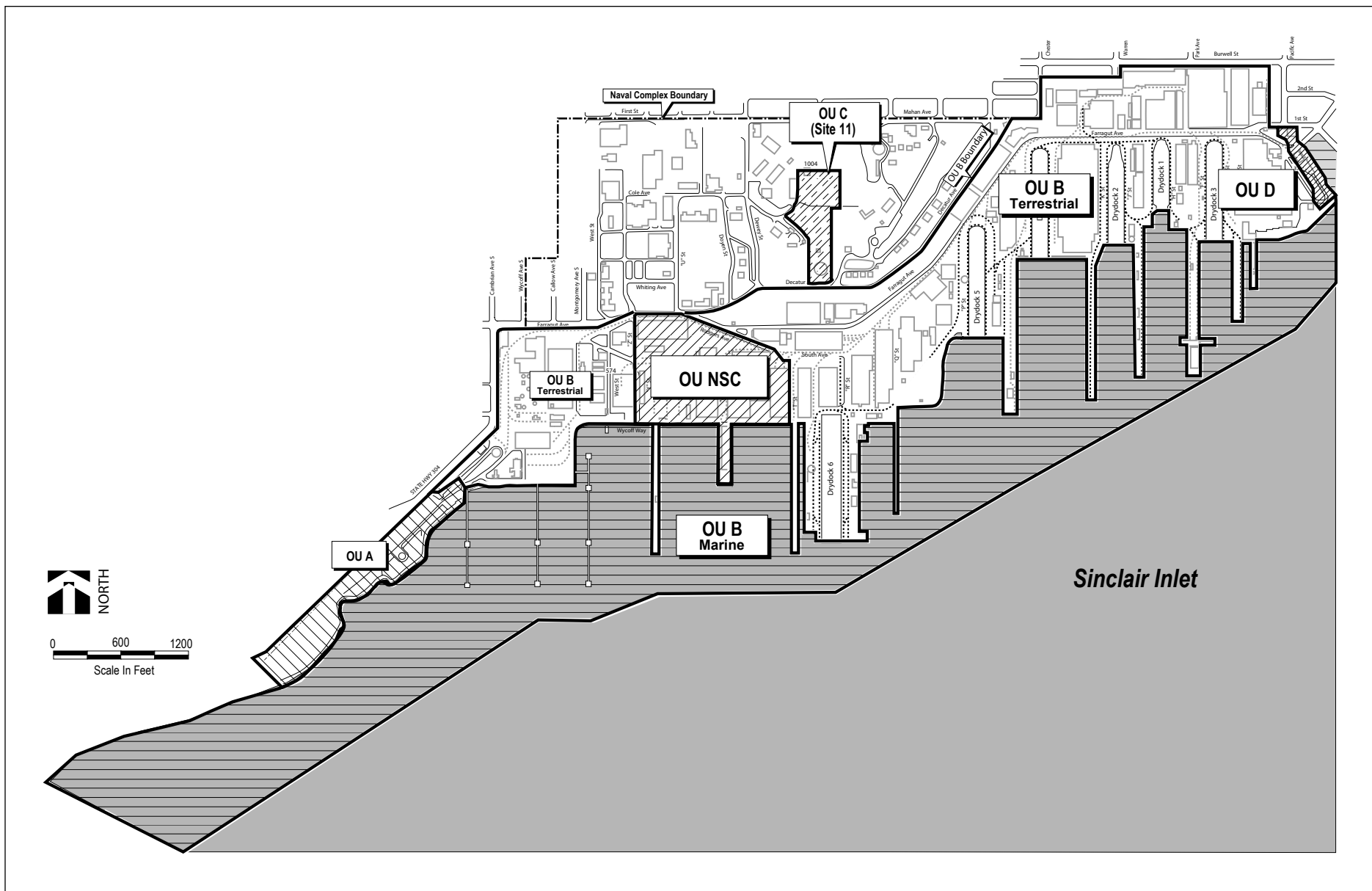
The Navy has been investigating the potential of transferring a portion of OU B T to the City of Bremerton for the development of a public park. OU B T was evaluated under an industrial land use scenario, and further investigation was required to address the potential change from industrial to recreational land use. OU D was developed to define the area of additional investigation and consisted of 5.3 acres as shown in Figure 1-2; however, the extent of the potential transfer was not defined. Subsequent to the investigation, the Navy defined the area available for transfer. The boundary of OU D, therefore, has been reduced to the area of land available for use under recreational land use. OU D as revised includes the easternmost 2.5 acres of BNC, as shown in Figure 1-3.



**U.S.NAVY**

**Figure 1-1  
Bremerton Naval Complex Vicinity Map**

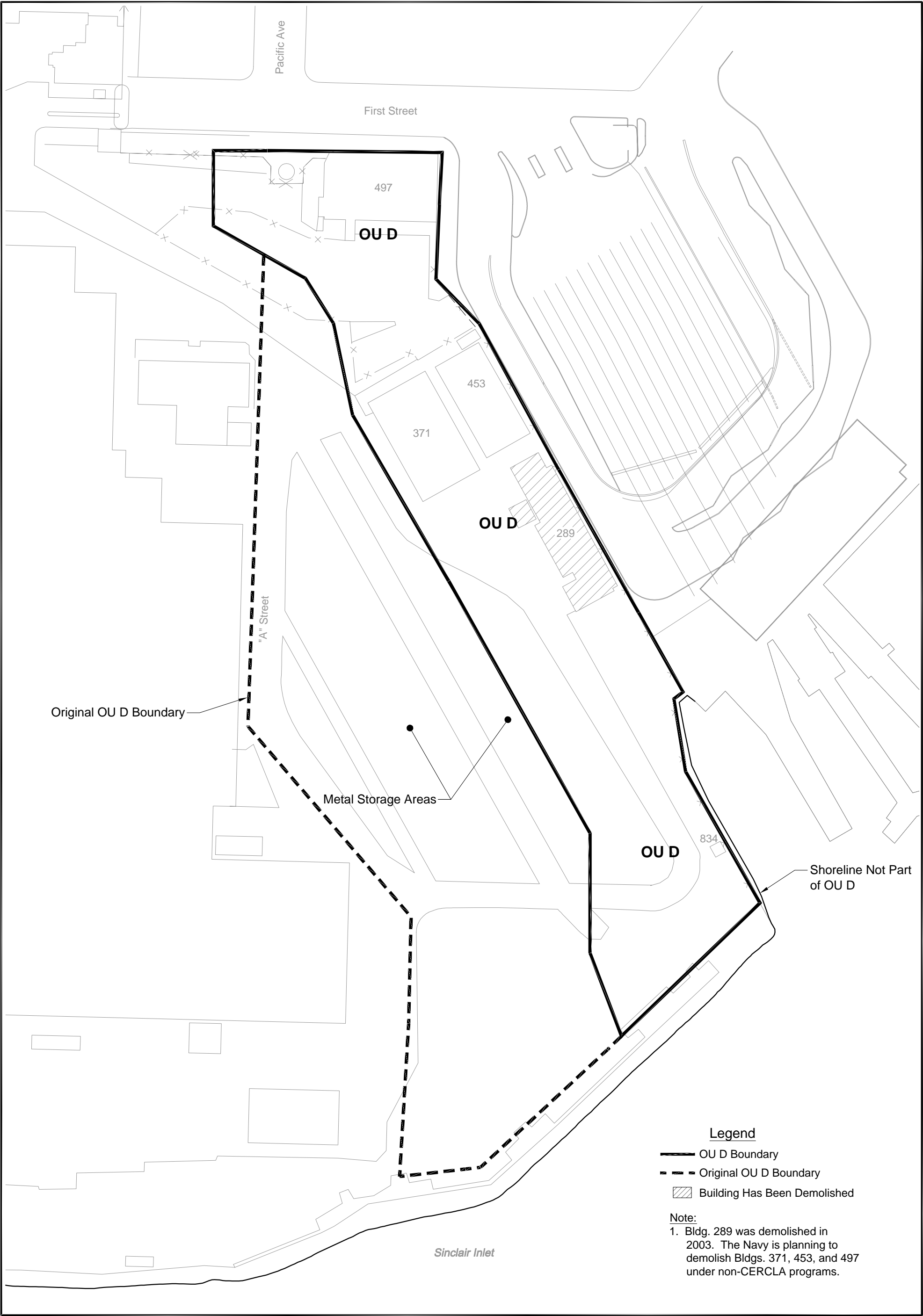
Delivery Order 0002  
Bremerton Naval Complex, OU D  
Bremerton, WA  
FINAL ROD



**U.S.NAVY**

**Figure 1-2**  
**Bremerton Naval Complex Operable Units**

Delivery Order 0002  
 Bremerton Naval Complex, OU D  
 Bremerton, WA  
 FINAL ROD



## **2.0 SITE NAME, LOCATION, AND DESCRIPTION**

### **2.1 SITE NAME AND LOCATION**

BNC is located in the City of Bremerton, in Kitsap County, Washington (see Figure 1-1). The site is physically located at latitude 47°33'N and longitude 122°38'W. The Navy maintains a total of 1,350 acres of property along the shoreline of Sinclair Inlet, an arm of Puget Sound. OU D is situated along the eastern border of BNC (Figure 1-2), directly west of the Washington State ferry terminal. OU B T makes up most of the shoreline area at BNC, including all of the shoreline near OU D. OU D includes no shoreline. Figure 2-1 is an aerial view of BNC and the City of Bremerton, looking to the northeast.

The boundaries of OU D were redefined as explained in Section 1. The following site description applies to the currently defined OU D.

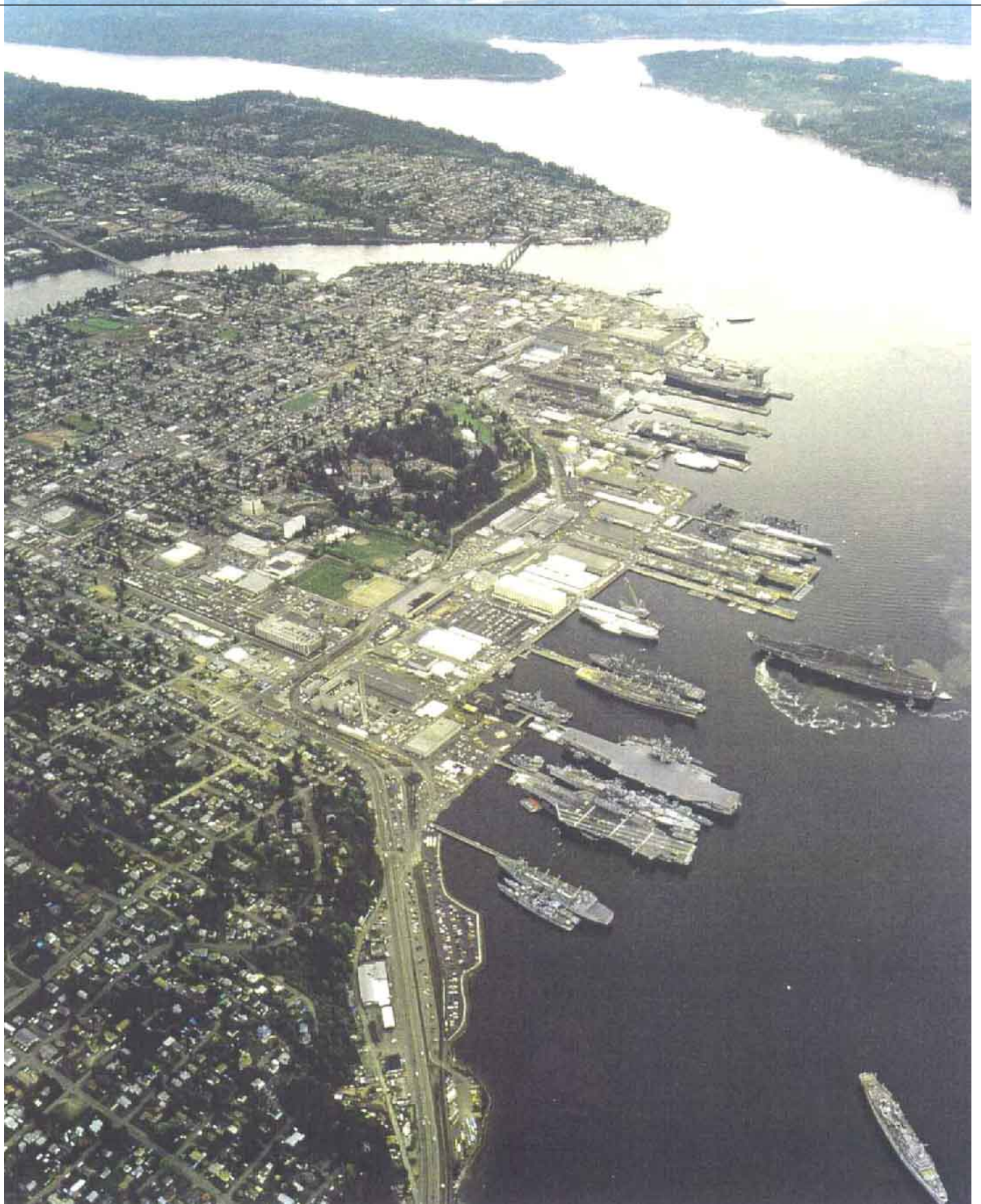
### **2.2 SITE DESCRIPTION**

BNC consists of two major commands: Naval Base Kitsap at Bremerton (NBK at Bremerton) and Puget Sound Naval Shipyard and Intermediate Maintenance Facility (PSNS & IMF), Bremerton site. The boundaries of these commands along with the relative location of OU D with its redefined boundaries are shown in Figure 2-2. The primary role of NBK at Bremerton is to serve as a deep draft home port for aircraft carriers, supply ships, and two Maritime Administration crane ships, with associated supply, retail, and housing support facilities. NBK at Bremerton occupies the western portion of BNC and is a fenced, secure area.

The primary role of PSNS & IMF is to provide overhaul, maintenance, conversion, refueling, defueling, and repair services to the naval fleet. PSNS & IMF has the capability to drydock and work on all classes of Navy vessels and safely dispose of decommissioned nuclear powered ships. PSNS & IMF has six drydocks, eight piers and moorings, and numerous industrial shops to support the industrial operations. PSNS & IMF occupies the eastern portion of BNC, and access is strictly controlled.

OU D falls within the physical boundary of PSNS & IMF. PSNS & IMF has used the OU D area primarily for administrative support functions and a metal storage area (Figure 1-3). Unlike many other portions of PSNS and IMF, little heavy industrial activity has occurred at OU D. OU D contains Buildings 371, 453, and former Building 289, which are adjacent to the eastern boundary of the site (Figure 1-3); Building 497 at the north end of the site; and a metal storage area in the western and central portions of the site. Buildings 371 and 453 served as the

chemistry and geotechnical laboratories, respectively, at BNC until their closure in 2003. Building 289 operated as a welding shop until its closure and demolition in 2003. Building 497 houses the BNC police station and specialized electrical systems and related staff for BNC. Before the Navy purchased Building 497 in 1941, the building had been used as a Montgomery Ward store, several taverns, a bus terminal, and a clothing store. After the Navy purchased the building, Building 497 housed the PSNS police and Marine Guard Headquarters.



**U.S.NAVY**

Delivery Order 0002  
Bremerton Naval Complex, OU D  
Bremerton, WA  
FINAL ROD

**Figure 2-1**  
**View to Northeast Over Bremerton Naval Complex**



### **3.0 SITE HISTORY AND ENFORCEMENT ACTIONS**

#### **3.1 BREMERTON NAVAL COMPLEX**

The BNC became the Pacific Northwest's first permanent naval installation in 1891. Table 3-1 shows a chronological listing of key events at the BNC from the time of the purchase of the original 190-acre site through expansion to its current size of approximately 1,350 acres and role as a home port for Navy vessels and the Navy's largest ship repair and overhaul facility on the West Coast. With 6 major piers, 6 drydocks, and almost 400 buildings and support facilities, the BNC remains a key naval facility in the forefront of repair, maintenance, and conversion of Navy surface ships and submarines.

Waste streams at BNC have included metal plating wastes, filings and shavings associated with metal work, petroleum products, transformers containing polychlorinated biphenyls (PCBs), electrical components, batteries, acids, oxidizing materials, paints and paint chips, degreasing and cleaning solvents, and wood and miscellaneous materials from shipbuilding and ship dismantling. Waste disposal practices that were consistent with industry standards and widely accepted at the time—particularly the use of miscellaneous waste material as fill during expansion of the BNC—together with historical spills and leaks of industrial materials have led to elevated levels of various chemicals in BNC soil and groundwater. The types of fill encountered during subsurface sampling and the chemicals detected in the soil and groundwater are consistent with these types of contaminant sources. Portions of additional land acquired by the Navy to accommodate shipyard growth were likely also contaminated prior to Navy purchase. For example, land purchased west of the original shipyard area included waste disposal areas used by residents of the former community of Charleston.

Modern-day industrial operations and facilities at the BNC include metal machining, electrical, boilermaking, electronics, print, photo, and paint shops, pesticide operations, transportation operations, fuel storage facilities (aboveground and underground tanks and pipelines), firefighting operations, and medical facilities. Wastes generated by these operations are subject to current regulations.

#### **3.2 INVESTIGATIONS AND CLOSURE/REMOVAL ACTIONS**

Investigations at OU D, which are described in this section, refer to the originally defined OU D, because the OU D boundaries were not redefined until after the OU D-specific studies were completed.

An initial assessment study was conducted in 1983 to identify and assess sites potentially contaminated by chemicals present in fill material or by historical use of chemicals at BNC. The study identified six potentially contaminated sites and came to the overall conclusion that each of these sites posed no immediate threat to human health or the environment. A supplemental report published in 1990 identified five additional potentially contaminated sites.

During 1990 and 1991, the Navy conducted a site inspection (SI) of the BNC. In 1992, Ecology placed the site on the state hazardous sites list and issued Enforcement Order 92TC-112 directing the Navy to prepare remedial investigation (RI) and feasibility study (FS) reports for the site. In January 1994, the Navy, in conjunction with Ecology and EPA, issued project plans for a two-phased RI and subsequent FS for OU B.

Numerous studies of the conditions at the BNC were performed before the formal RI began in 1991. These studies included several complex-wide investigations of potential contamination based on information regarding historical site use. These earlier studies helped to prioritize later studies, including the RI. As part of the RI, sampling and analysis were performed to collect information regarding potential contaminants at OU B. The sampling concentrated on soil, groundwater, drydock seeps, drydock drainage channels, drydock drainage outfalls, and storm drain system sediments and stormwater. From the analyses that were performed, the chemicals of interest at OU B were determined to be volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/Aroclors, total petroleum hydrocarbons (TPH), and heavy metals.

In May 1994, the EPA placed the BNC on the NPL. The BNC has been divided into several OUs, including OU A, OU B M, OU B T, OU C, and OU NSC. OU C was evaluated as a petroleum-contaminated site. OU A, OU B M, and OU NSC have been the focus of prior remedial actions.

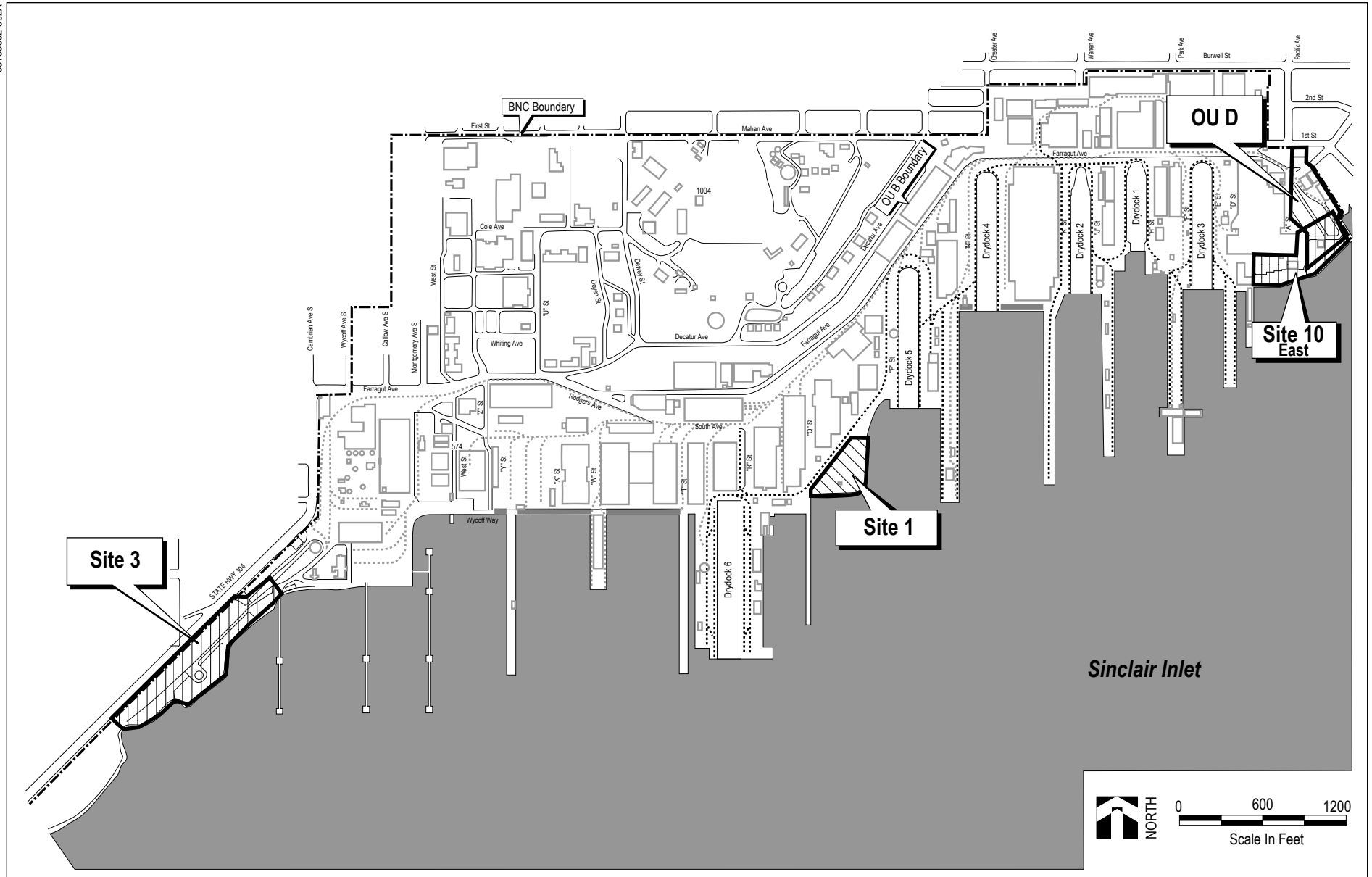
Approximately the southern third of OU D was evaluated as a portion of Site 10 East under the RI for OU B in 1991, 1995, 1997, and 2000 (Figure 3-1). Site 10 East, which covers approximately 5 acres, extends from Pier 8 to near the eastern edge of BNC and is a suspected disposal site. Disposal activities are suspected to have occurred during the filling of this area. Fill was added to level areas near the shoreline. This area was filled in with miscellaneous materials, and spent sandblasting grit may have been used as a fill component. Sandblast grit was used primarily in drydocks up to the mid-1950s as blasting material for removing paint and cleaning ship hulls. Samples of grit from Sites 1 and 3 at BNC contained arsenic, copper, lead, and zinc in concentrations above 2001 MTCA Methods C and A industrial soil criteria. Other metals, such as barium, chromium, iron, nickel, silver, and tin, were also detected in spent grit samples.

During the RI studies of Site 10 East, two soil borings were drilled in the southern portion of OU D in 1991, and a groundwater monitoring well was installed in 1995. Soil samples were analyzed for VOCs, SVOCs, inorganics, TPH, pesticides, and PCBs. Soil samples were collected every 5 feet, starting at 0 to 2 feet below ground surface (bgs) to the total depth of each boring (between 20 to 27 feet bgs). Laboratory results indicated detections of volatile and semivolatile organic compounds, inorganics, PCBs, and petroleum hydrocarbons. A groundwater sample collected from the well in 1995 was tested for total and dissolved inorganics and TPH-diesel. No detected concentrations in the groundwater exceeded their respective screening values.

In 1997, groundwater and soil samples were collected from four locations near Building 497. Soil samples from four locations were analyzed for TPH-gasoline, TPH-diesel, TPH-other, cadmium, copper, lead, and zinc. No TPH was detected in soil samples. Copper, lead, and zinc were detected at concentrations less than the MTCA Methods A and B soil cleanup levels. One groundwater sample was collected and analyzed for TPH-gasoline, TPH-diesel, and TPH-other. No TPH concentrations were detected.

Shallow soil sampling was conducted in October 2000 at six locations around the perimeter of Buildings 371 and 453. Soil samples were analyzed for VOCs, SVOCs, total inorganics, TPH, and PCBs. Soil samples were collected at approximate intervals of 0.1 to 0.5 foot, 1 to 2 feet, 2 to 2.5 feet, and 4 to 5 feet bgs. TPH-diesel, TPH-heavy oils, and carcinogenic polycyclic aromatic hydrocarbon (cPAHs) were present at concentrations that exceeded MTCA Method A values for TPH and MTCA Method B unrestricted values for cPAHs.

In 2003, sampling was performed specifically for the OU D RI/FS. Fifteen surface soil (0 to 2 feet bgs) samples and 18 subsurface samples from 5 shallow borings (0 to 15 feet bgs) were collected within the OU D. Subsurface soil samples were collected from depth intervals of 0 to 2, 2 to 5, 5 to 10, and 10 to 15 feet. All samples were analyzed for priority pollutant inorganics (6000/7000), pesticides and PCBs (8081A/8082), semivolatile organics (8270 C/SIM), volatile organics (8260B), and gasoline- (NWTPH-G) and diesel- (NWTPH-D<sub>x</sub>) range hydrocarbons.



**U.S.NAVY**

**Figure 3-1**  
Locations of Sites 1, 3, and 10 East in Relation to OU D

Delivery Order 0002  
Bremerton Naval Complex, OU D  
Bremerton, WA  
FINAL ROD

**Table 3-1**  
**Key Events in Bremerton Naval Complex Site History**

<b>Date</b>	<b>Historical Activity or Event</b>
1891	Navy purchases 190 acres of land on Sinclair Inlet for construction of a drydock and base for ship repair and overhaul.
September 1891	The base is designated the Puget Sound Naval Station; Lt. Ambrose B. Wyckoff assumes command of the region's first naval installation.
Spring 1896	Drydock 1 and miscellaneous support facilities are completed.
1901	The base is redesignated the Puget Sound Navy Yard (PSNY). Support facilities are under construction, including a second drydock (Drydock 2) designed for shipbuilding.
1914–1918	The construction of Drydock 3 occurs during World War I. PSNY has its first change in mission—new vessel construction begins in addition to overhauls. At this time, PSNY is the only shipyard on the West Coast capable of repairing armored battleships.
1919–1921	Upland filling and earthwork expand the industrial area of PSNY. A total of 25 submarine chasers, 6 submarines, 2 mine sweepers, 7 oceangoing tugs, 2 ammunition ships, and 1,700 small boats had been constructed at the yard through 1921.
1926	Pier 6, PSNY's largest pier, is constructed.
1930s	Upland expansion continues at PSNY.
1938–1945	World War II results in a major expansion of PSNY, including additional shore facilities, two new piers, and construction of Drydocks 4 and 5. A total of 394 fighting vessels are built, fitted out, repaired, or overhauled at PSNY during the 44 months of the war.
November 1945	PSNY is renamed the Puget Sound Naval Shipyard (PSNS). Decommissioning of the war fleet becomes a major activity.
1947	Mooring facilities are constructed to berth "mothballed" vessels.
1950–1953	The Korean War places new production demands on PSNS. Modernization of World War II carriers to accommodate modern jet aircraft begins.
Mid-1950s	PSNS begins construction of guided-missile frigates.
1961	BNC becomes part of the Navy's nuclear power program. Drydock 6 is completed in the early 1960s.
1964	PSNS provides logistical support for all Polaris submarines and support craft assigned to the Pacific Ocean. Ship and submarine overhauls become major activities, as well as construction of the first of the USS Sacramento class of fleet combat support ships.
1967	The Naval Supply Center (NSC) is commissioned at BNC and assigned management responsibility for the Navy's increasing support needs in the Pacific Northwest.
1970s	After several ships are built in the early 1970s, PSNS ends its mission of new vessel construction and engages exclusively in repair, overhaul, and conversion work.
1973	Closure of naval shipyards in Boston, Massachusetts, and San Francisco, California (Hunter's Point) leads to increase in BNC's role in ship repair and refueling for the Pacific fleet.
1975	Navy begins overhauling aircraft carriers at BNC at a frequency of about one per year. Fill activities occur in the immediate area of Mooring A; the shoreline fill limits match those of the present-day BNC.
1980	Navy files Notice of Hazardous Waste Activity.
July 31, 1990	Preliminary Assessment of the BNC is completed.

**Table 3-1 (Continued)**  
**Key Events in Bremerton Naval Complex Site History**

<b>Date</b>	<b>Historical Activity or Event</b>
March 6, 1992	Washington State Department of Ecology Enforcement Order DE92 TC-006 is issued for NSC.
May 15, 1992	Site inspection (SI) report is issued.
May 15, 1992	Washington State Department of Ecology Enforcement Order DE92 TC-112 is issued for PSNS.
August 1992	Reorganization of operable units is proposed.
January 11, 1993	U.S. Environmental Protection Agency (EPA) completes evaluation of BNC according to the Hazard Ranking System, which is a numeric estimate of relative severity of a hazardous substance release or potential release.
March 1, 1993	NSC is renamed the Fleet and Industrial Supply Center (FISC).
May 10, 1993	BNC is proposed for inclusion on the National Priorities List (NPL).
May 31, 1994	BNC is added to the NPL.
December 13, 1996	Record of Decision (ROD) is signed for OU NSC.
January 24, 1997	ROD is signed for OU A.
August 31, 1998	Navy, EPA, and State of Washington sign interagency agreement for BNC.
October 1998	New Command Naval Station Bremerton is established.
June 13, 2000	ROD is signed for OU B Marine.
August 2002	OU D is established.
May 15, 2003	PSNS and NAVIMFAC PACNORWEST merge into a single maintenance organization Puget Sound Naval Shipyard and Intermediate Maintenance Facility (PSNS & IMF).
March 8, 2004	ROD is signed for OU B T.
June 4, 2004	Naval Station Bremerton and Submarine Base Bangor merge to become Naval Base Kitsap (NBK).

Note:  
 OU - operable unit

**Table 3-2**  
**Summary of Historical Terrestrial Investigations and Closure/Removal Actions**

Report	Location	Summary
<b>Comprehensive Environmental Assessments</b>		
<i>Preliminary Assessment Supplemental Report, Puget Sound Naval Shipyard, Bremerton, Washington.</i> NEESA 13-022A. Port Hueneme, California. June 1990.	PSNS	PA updated IAS report and identified Sites 7 through 11. Report recommended that Sites 1, 6, 7, 8, 9, 10, and 11 be included in the Site Inspection phase of Installation Restoration Program. No environmental sampling of groundwater, surface water, or soil was conducted for the report.
<b>Comprehensive Environmental Investigations</b>		
<i>Site Inspection Study, Puget Sound Naval Shipyard, Bremerton, Washington.</i> 4 vols. Prepared for U.S. Navy CLEAN Contract N62474-89-D-9295 by URS Consultants, Inc. (URS). Seattle, Washington. May 15, 1992.	OU B T Sites 1, 7, 8, 9, 10 East, 10 Central, 10 West, and OU B Marine Site 6. Site 3 (OU A), Site 11 (OU C), and Site 12 (OU NSC) were also studied.	Extensive environmental sampling of soil and groundwater at the SI terrestrial sites was conducted for HRS scoring. No analysis of TPH in soil or groundwater was conducted despite visual evidence at Site 8. Generally, carcinogenic PAHs and inorganics (especially arsenic, copper, and lead) were found at elevated levels in soil from SI sites throughout the BNC.
<b>Site Investigations and Closure/Removal Actions</b>		
<i>Amended Final Report of Findings, Subsurface Soil Investigation Beneath Building 873, Puget Sound Naval Shipyard, Bremerton, Washington.</i> Prepared for U.S. Navy CLEAN Contract N62474-89-D-9295 by URS. Seattle, Washington. 1995.	OU B T north of Site 10 Central	Soil beneath plating, painting, and sandblasting shop in Building 873 was investigated. Environmental sampling of the soil for VOCs, cadmium, hexavalent chromium, silver, lead, and cyanide showed exceedances of MTCA Method A industrial soil criteria for lead and MTCA Method B residential soil criteria for cadmium and hexavalent chromium. Hexavalent chromium results may have been understated relative to total chromium based on soil extraction method used. One location may have exceeded the 2001 MTCA Method C industrial soil criterion for hexavalent chromium.

**Table 3-2 (Continued)**  
**Summary of Historical Terrestrial Investigations and Closure/Removal Actions**

Report	Location	Summary
<p><i>Geotechnical Report Abrasive Blast Facility, P162, Puget Sound Naval Shipyard, Bremerton, Washington.</i> Prepared for the Navy by Shannon &amp; Wilson. Seattle, WA. 1991;</p> <p><i>Draft Geotechnical Report Abrasive Blast Facility, P192, Site B, Puget Sound Naval Shipyard, Bremerton, Washington.</i> Prepared for the Navy by Shannon &amp; Wilson. Seattle, Washington. 1992;</p> <p><i>Draft Remedial Characterization/ Feasibility Study, Abrasive Blast Facility, Puget Sound Naval Shipyard, Bremerton, Washington.</i> Prepared for the Navy by Shannon &amp; Wilson. Seattle, Washington. 1993;</p> <p><i>Geotechnical Services, Environmental Sampling, and Testing, Mooring Buoy Electrical Duct Bank, Puget Sound Naval Shipyard, Bremerton, Washington.</i> Prepared for the Navy by GeoEngineers. 1992;</p> <p><i>Geotechnical and Environmental Study P 283, Bachelors' Enlisted Quarters, Puget Sound Naval Shipyard, Bremerton, Washington.</i> Prepared for the Navy by Hart Crowser. 1991;</p> <p><i>Results of Geotechnical Investigation (Fuel Tank Depot at Building 592) at Puget Sound Naval Shipyard, Bremerton, Washington.</i> Prepared for the Navy by Stan Palmer Construction. 1989;</p> <p><i>Geotechnical Report, Oily Wastewater Collection System (P-240), Puget Sound Naval Shipyard, Bremerton, Washington.</i> Prepared for the Navy by Bouillon Christofferson &amp; Schairer, Inc. September 1994.</p>	<p>Various locations within OU B T</p>	<p>Geotechnical and environmental studies were conducted prior to construction of new facilities at PSNS. All studies included collection of soil boring samples where TPH was detected at least once above MTCA Method A soil cleanup levels. Several of the sites investigated are located in Site 10 West, which, in addition to TPH, contained soils with arsenic, cadmium, and mercury above MTCA Method A industrial soil cleanup levels. Characterization of TPH contamination during geotechnical and environmental studies was based on more stringent MTCA Method A soil cleanup levels in effect for TPH prior to the August 2001 revision to MTCA.</p>

**Table 3-2 (Continued)**  
**Summary of Historical Terrestrial Investigations and Closure/Removal Actions**

<b>Report</b>	<b>Location</b>	<b>Summary</b>
<i>Final Closure Report, Treatability Study, OU B, PSNS, Bremerton, Washington. November 5, 2002.</i>	Central OU B T	Cleaning and inspection of a subset of stormwater system to refine basis for stormwater system restoration planning.
<i>Draft Removal Action Closure Report, Asphalt Pavement Cap, East End Capping – Operable Unit D, Bremerton Naval Complex, Bremerton WA Oct 5, 2004</i>	OU D	New asphalt pavement and stormwater system.
<b>Other Terrestrial Studies</b>		
<i>Revised Final Storm Water Base Map Report, Puget Sound Naval Shipyard. Prepared for the Navy by EMCON Northwest, Inc. (EMCON). December 1992;</i> <i>Final Submittal; Outfall, Drydock and Parking Lot Study, Puget Sound Naval Shipyard. Prepared for Navy by EMCON. October 1993;</i> <i>Revised Final Submittal; Storm Water Base Map Update, Puget Sound Naval Shipyard. Prepared for the Navy by EMCON. October 1993;</i> <i>Evaluation of Storm Sewer for NPDES Violations, Puget Sound Naval Shipyard Bremerton, Washington, Final Submittal. Prepared for the Navy by Sitts &amp; Hill Engineers, Inc. (Sitts &amp; Hill). December 1993; Final Submittal, Stormwater Base Map Update, Phase III. Prepared for the Navy by Sitts &amp; Hill. March 1994.</i>	PSNS	Multiple-phase investigation of stormwater facilities at PSNS was conducted on behalf of the Navy to update stormwater base map and identify noncomplying inflows to the stormwater system. No environmental sampling was conducted. Noncomplying flows were subsequently addressed under the shipyard NPDES program.
<i>Data on Quantity and Quality of Water Flowing in Drainage Systems of Dry Docks at Puget Sound Naval Shipyard, Bremerton, Washington, 1994. Open-File Report 95-361. Prepared for the Navy by E. Prych of U.S. Geological Survey.</i>	Drydocks 1-6	USGS studied drydocks at PSNS to obtain information for use in investigations of the movement of chemicals in groundwater. Data on waste discharge rates were collected at various locations in the drainage systems of the drydocks. Environmental samples were collected from the drydocks and analyzed for copper, lead, VOCs and SVOCs. Environmental sampling results were similar to those obtained during OU B Phase I sampling.

**Table 3-2 (Continued)**  
**Summary of Historical Terrestrial Investigations and Closure/Removal Actions**

Notes:

HRS - hazard ranking system  
IAS - initial assessment study  
MTCA - Model Toxics Control Act (Washington State)  
OU - operable unit  
OU NSC - Operable Unit Naval Supply Center  
PA - preliminary assessment  
PAH - polycyclic aromatic hydrocarbon  
PSNS - Puget Sound Naval Shipyard  
SI - site inspection  
SVOC - semivolatile organic compound  
TPH - total petroleum hydrocarbons  
USGS - United States Geological Survey  
VOC - volatile organic compound

## 4.0 COMMUNITY PARTICIPATION

The Navy published a Community Relations/Public Participation Plan in October 1992. In conjunction with the publication of this plan, a Technical Review Committee (TRC) was established, consisting of representatives of the Navy and other governmental agencies and formal groups.

In 1994, the BNC began a transition from the regulatory agency-based TRC to a community-based Restoration Advisory Board (RAB). To ensure the community had sufficient opportunity to participate in the process, 26,000 brochures were mailed to the surrounding community. The address list included all residences and businesses within one mile of the BNC, as well as other stakeholders such as elected officials, religious groups, nonprofit environmental organizations, news media, and Native American groups for whom the Sinclair Inlet area was ancestral land. Additionally, a series of open houses were held to provide information on cleanup and allow the community to ask questions about the RAB. About 20 individuals expressed interest in being on the RAB. By the spring of 1995, a community co-chair had been selected by the community members of the RAB, bylaws had been written, and the RAB was meeting on a regular basis.

Since the inception of the RAB, general attendance at the meetings has declined. Attendance is usually about 15 people, with about 10 of the people representing the Navy or regulatory community. Meetings are held on an as-needed basis.

The Navy published a Community Involvement Plan (CIP) for the BNC in April 1996, replacing the Community Relations/Public Participation Plan. The new plan's goals are as follows:

- To encourage communication between the Navy and local community
- To encourage public participation in decision-making
- To focus on issues of interest to the community during the study and cleanup process
- To be open to change based on community involvement needs

Information on the Technical Assistance for Public Participation (TAPP) grants program was provided to community members at the April 1998 RAB meeting. There has been no interest expressed in obtaining a TAPP grant.

The Proposed Plan for OU D, formally presenting the preferred cleanup alternative, was issued for public comment on June 28, 2004, through a mailing to over 1,200 interested community members.

A public meeting to present the Proposed Plan was held in conjunction with an open house on August 11, 2004. A notice of availability was published in the *Bremerton Sun* on August 6 and 8, 2004, and in the *Northwest Navigator* on August 6, 2004. The public comment period extended through August 25, 2004. Approximately 30 people (Navy, EPA, Ecology, Suquamish Tribe, City of Bremerton, and members of the public) attended the open house and public meeting, including representatives from the *Bremerton Sun* and *Central Kitsap Reporter*. Comments were received from the attendees during the question and answer portion of the public meeting. Additional comments/questions were received in writing during the remainder of the public comment period. The comments and questions are summarized in the Responsiveness Summary along with the responses provided by the Navy.

The final RI/FS for OU D, together with other significant documents, have been made available for public review at the following branches of the Kitsap County Regional Library:

Central Branch  
1301 Sylvan Way  
Bremerton, Washington

Rev. Martin Luther King, Jr., Branch  
612 Fifth Avenue  
Bremerton, Washington

The Administrative Record for OU D, including the RI/FS report and other documents forming the basis for this ROD, are available for public review by contacting:

Engineering Field Activity, Northwest  
Naval Facilities Engineering Command  
19917 Seventh Avenue Northeast  
Poulsbo, Washington 98370-7570  
(360) 396-0012

## **5.0 SCOPE AND ROLE OF OU D**

OU D is one of six OUs at BNC. OU A, OU B M, OU B T, OU NSC, and OU D are CERCLA units managed under the federal Superfund program, and OU C is a petroleum unit managed under the state cleanup program. OUs A, B, C, and NSC were originally defined and established based on consideration of the Navy's command structure at BNC, geography, site history, and suspected site contamination (Figure 1-2). The original OU B was divided into two operable units, OU B M and OU B T, in 1999 to allow cleanup of the marine area to be accelerated. OU D was segregated from OU B T in August 2002 in connection with the Navy's evaluation of a possible land transfer to the City of Bremerton. This ROD for OU D is expected to be the last ROD for the BNC NPL site.

Separate decision documents for OU A and OU NSC have been completed, and the remedial actions specified in the RODs for those units were implemented and completed in 1998 and 1999, respectively. The primary remedy component at OU A was containment of contaminated fill through upgrades to pavement and installation of riprap for shoreline erosion control. The primary components of the remedy at OU NSC were containment of contaminated fill through pavement upgrades, removal of contaminated sediment and debris from the stormwater system, and repair of damaged stormwater facilities.

The ROD for OU B T was signed March 8, 2004. The remedy for OU B T includes stormwater system restoration, pavement installation and repairs, shoreline stabilization, institutional controls, and groundwater monitoring. The Final Action Memorandum for OU B dated February 8, 1998, describes the asphalt and concrete cap that was planned and eventually installed at OU B T.

OU B M and adjoining portions of Sinclair Inlet were addressed in the OU B M ROD issued in June 2000 and a subsequent Explanation of Significant Differences (ESD) issued in February 2004. The remedy for OU B M initially involved dredging of contaminated marine sediments, confinement of these sediments in an excavated seafloor pit, capping of other contaminated sediments, and shoreline stabilization. The ESD modified the action levels for the response action on Washington State Owned Aquatic Lands (SOAL) adjacent to the pit and addressed institutional control requirements on the SOAL. The remedial construction for OU B M ROD was completed in 2004.

Because petroleum, which is not a hazardous substance under CERCLA, was the primary contaminant found at OU C, this operable unit is not managed as a CERCLA site. A focused RI/FS for OU C was prepared under MTCA and published in April 2002, and a steam-sparging

system has been used to recover subsurface petroleum. The Navy and Ecology are evaluating potential additional remedial actions for OU C, and a Cleanup Action Plan is planned for OU C.

OU D was established in 2002 from a portion of the OU B T at the east end of BNC. The Navy revised the boundary of OU D to include the area that the Navy may transfer to the City of Bremerton for recreational use. OU D also includes a 20-foot strip of land to be retained by the Navy, which will serve as a buffer on the east side of the Navy fence line. Therefore, the potential property line between the Navy and City of Bremerton is within the OU D boundaries. OU D is adjacent to the State ferry terminal at the eastern end of OU B T.

## **6.0 SUMMARY OF SITE CHARACTERISTICS**

The following sections summarize the primary characteristics of the originally defined OU D. This material has been drawn primarily from *Final Remedial Investigation/Feasibility Study Report, Operable Unit D, Bremerton Naval Complex, Bremerton, Washington*, dated March 2004. The RI/FS report was completed before the OU D boundaries were redefined; therefore, this section refers to the originally defined OU D.

### **6.1 PHYSICAL SETTING**

#### **6.1.1 Location**

OU D is the easternmost 5.3 acres of BNC (Figure 1-2). It is adjacent to the Washington State ferry docks in Bremerton. OU D is relatively flat and has a surface elevation of less than 25 feet above mean sea level.

#### **6.1.2 Physical Characteristics**

The area occupied by BNC has been greatly modified from its original condition. Historically the area consisted of tidelands, marshes, and forests. The area was cleared and filled in several stages beginning in the late 1800s through 1975. The area adjacent to the waterfront where OU D is located was filled to create land to accommodate naval operations (Figure 6-1). OU D does not include the shoreline along Sinclair Inlet; the shoreline immediately south and southeast of OU D is part of OU B T. The topography is generally flat over most of the site, except the northern section of the site, which rises slightly in elevation.

The industrial waterfront at BNC ranges in elevation from sea level to 25 feet above mean sea level. The hillsides adjacent to the waterfront reach a maximum elevation of 170 feet. There are no streams or wetlands at BNC. BNC does not lie within a 100-year floodplain. BNC includes almost 400 buildings, 6 drydocks, and 14 piers and moorings. More than 95 percent of OU B T is paved (i.e., about 228 acres of the 240-acre OU B T site are paved, which includes the area redesignated as OU D), minimizing infiltration and subsequent leaching of chemicals in unsaturated soil to groundwater. In comparison, approximately 50 percent of OU D is unpaved, or about 2.5 acres of the 5.3-acre site. A majority of the unpaved area is in the southern half of the site. The Navy currently uses much of the unpaved area as a metal storage area.

Groundwater and stormwater flow from the higher areas of BNC toward Sinclair Inlet. Continuous pumping of groundwater is required in the vicinity of the drydocks to relieve hydrostatic pressures that would otherwise tend to lift and potentially damage the drydocks. The groundwater flow direction is influenced by the operation of these drydock drainage relief systems (Figure 6-2). Operation of the drainage relief systems also increases the natural rate of intrusion of seawater into the soil along the shoreline in the vicinity of the drydocks. Most shallow groundwater and intruding seawater in central and eastern OU B T and OU D pass through the drydock drainage relief systems before being discharged to the inlet.

Precipitation and resulting surface runoff over paved areas at OU D are collected by a stormwater system and discharged to the inlet.

## **6.2 CULTURAL RESOURCES**

The 1855 Treaty of Point Elliott promulgated articles of agreement between the United States and the Suquamish Tribe. An aboriginal right retained under the Treaty includes the immemorial custom and practice to hunt, fish, and gather within usual and accustomed grounds and stations, which was the basis of the Tribe's source of food and culture. Sinclair Inlet is within the Suquamish Tribe's usual and accustomed fishing area.

Suquamish ethnographic place names have been identified within Sinclair Inlet and the boundaries of BNC. Although no hunter-fisher-gatherer archaeological sites have been found at the facility, areas within BNC are identified as having a probability for such resources. Northern areas within OU D are identified as having a high probability for hunter-fisher-gatherer archaeological sites and moderate probability for historic period resources at depths below most normal excavations. Southern areas within OU D are identified as having a low probability for hunter-fisher-gatherer archaeological sites and no probability for historic period resources.

PSNS & IMF, Bremerton site is a National Historic Landmark District. Four historic districts are located within Naval Base Kitsap at Bremerton. None of these districts is located within OU D.

## **6.3 BIOLOGICAL RESOURCES**

As an industrialized site, OU D includes little natural habitat area. However, the adjacent waters of Sinclair Inlet, including OU B Marine, support a wide variety of biological resources. For example, common invertebrates in the inlet include clams, mussels, and crabs. Among the marine finfish observed in the inlet, sole, flounder, perch, and herring are comparatively

abundant. The inlet also acts as a migration corridor for species such as chinook, coho, and chum salmon and cutthroat and steelhead trout. Endangered and threatened species that are commonly observed in the vicinity include chinook and coho salmon and bald eagles.

#### **6.4 NATURE AND EXTENT OF CONTAMINATION**

Results from 70 soil samples collected from 1991 through 2003 at OU D were used to evaluate the nature and extent of contaminants in the soil. Samples collected from previous evaluations, such as samples used for the OU B evaluation and building-specific evaluations were incorporated into the data set. Most of the data used for the evaluation of OU D were gathered in 2003. Table 6-1 summarizes the types of analyses conducted for soil samples collected at locations within OU D.

Groundwater below OU D was not directly evaluated because groundwater below BNC (including OU D) was collectively assessed as part of the OU B RI. Groundwater beneath the BNC is nonpotable because throughout most of the low-lying shoreline at BNC, intruding seawater combines with the groundwater, producing a brackish mixture. Furthermore, observations during sampling suggest that fresh water cannot be withdrawn from site wells in sufficient quantity to serve as a viable drinking water source. Groundwater at OU D is not currently a drinking water source and is not expected to be a source of drinking water in the future. Groundwater from BNC, including OU D, ultimately discharges to Sinclair Inlet and was evaluated as part of the OU B RI, as it may impact the marine environment. It was concluded that groundwater at BNC is sufficiently protective of the marine environment and the recently implemented remedy for OU B Marine, and that active remediation of groundwater is not warranted.

The chemical data for OU D were subjected to a multi-step screening process to aid in organizing the RI discussion of nature and extent of contamination. This screening process was used to identify chemicals that appeared to merit primary attention, for example due to degree of exceedance or frequency of exceedance of various regulatory criteria. These chemicals were identified as chemicals of interest (COIs). The data screening discussed in Section 8 in connection with the risk assessment process was a completely separate analysis.

To begin the screening process, surface and subsurface soil analyte concentrations were compared to MTCA Method B values (WAC 173-340-740). The most stringent MTCA Method B value for each detected analyte was selected by comparing Method B values for unrestricted land use based on soil ingestion (carcinogenic and noncarcinogenic) and MTCA Method B values for protection of surface water. If no Method B value was established, then a MTCA Method A value was used. Method A values were used for TPH and PCB concentrations

only. If no Method A or Method B values were established for a detected analyte, then the EPA Region 9 residential risk-based screening concentration (RBSC) was used for the screening value. If there was no screening value based on the regulatory criteria for an analyte, the analyte was not retained as a COI.

For detected inorganics, screening values were compared to area background values for inorganics calculated for the site and presented in the OU B RI report. The area background concentration is a statistically derived value that represents the concentration expected to be present in the site soils under normal conditions (i.e., no known inorganic chemical impacts). The area background became the screening value for an analyte if the background concentration exceeded the screening criteria established by the regulatory criteria. Background concentrations were used as screening values for arsenic, cadmium, copper, mercury, and silver.

Analytes with concentrations that exceeded their screening values were further evaluated against additional criteria. These were the same additional criteria that were used to screen analytical data in the OU B RI. If 10 percent (or more) of the number of samples tested for an analyte exceeded the screening value, or the maximum detected concentration of the analyte exceeded two times the screening value, or the 95 percent upper confidence limit (UCL95) for the analyte exceeded the screening value, then the analyte was considered a COI. If none of those three criteria was true, then the analyte was not considered a COI. Table 6-2 evaluates the detected analytes against these criteria and identifies those analytes that are retained as COIs in OU D soil.

The following sections summarize by chemical categories the findings for the COIs identified as a result of this screening process for the soil.

#### **6.4.1 Volatile Organic Compounds**

Tetrachloroethene (PCE) was the only VOC that exceeded the screening criteria. PCE was detected in 5 of 59 samples with concentrations ranging from 0.0019 to 0.17 mg/kg. One sample from 5 to 7 feet at PS10E-SB03, which contained 0.17 mg/kg, exceeded the screening value of 0.0552 mg/kg (Table 6-2). PCE at this location may have been from fill material or a localized release. Figure 6-3 shows the location of this exceedance. Because the maximum value also exceeded two times the screening value, PCE was identified as a COI. All other VOCs detected were less than their corresponding screening levels.

#### **6.4.2 Semivolatile Organic Compounds**

Of the 58 samples analyzed for SVOCs, 25 individual analytes were detected. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene,

dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were detected in excess of their screening values (Table 6-2) and were identified as COIs. These analytes are collectively referred to as cPAHs. Individual cPAHs exceeded their screening values at nine of the sampled locations.

To represent the distribution of the total cPAHs based on toxicity equivalency, the total toxicity equivalent concentration (TTEC) was calculated for each sample where exceedances of individual cPAHs were detected. The measured concentration for each of the seven cPAHs was multiplied times the toxicity equivalency factor (TEF) to obtain a TTEC. TEFs are based on the relative toxicity to benzo(a)pyrene. The TECs are summed for each of the cPAHs to obtain the TTEC. Figure 6-4 shows the distribution of total cPAH (based on TTEC) detections that exceed the screening value of 0.137 mg/kg.

There does not appear to be a pattern in the distribution of the exceedances or a known source for most of the locations where these COIs were detected. It is possible that a minor petroleum surface release may have occurred near the back entrance and immediately east of Building 371, as suggested by the three of the four highest cPAH concentrations and TPH in samples collected from locations S-2 and CL-S04. The few deeper cPAH exceedances, such as at PS10E-SB02 and PS10E-SB03, may be a result of fill material placed at the site.

#### **6.4.3 Pesticides/PCBs**

Dieldrin, endrin, and 4,4-DDT were identified as COIs (Table 6-2). Although Aroclor 1260 and PCBs (total) had one detection (1.2 mg/kg) that exceeded the screening level of 1 mg/kg, these compounds are not COIs because less than 10 percent of samples tested exceeded the screening value, and the detected value was only 0.2 mg/kg higher than the screening value. Figure 6-3 shows the distribution of pesticide detections that exceed their screening value.

There does not appear to be a pattern in the distribution of the exceedances or a known source for these COIs. Because all exceedances are in the surface soil, the pesticides may be residual concentrations from former pesticide application to the soil in the unpaved areas.

#### **6.4.4 Inorganics**

Arsenic, cadmium, chromium, copper, iron, mercury, thallium, and zinc exceeded their screening values (Table 6-2). All of these inorganics, except thallium and iron, are COIs because more than 10 percent of the samples tested exceeded their screening criteria, their maximum concentration exceeded more than twice their screening value, or the UCL95 exceeded their screening value. Thallium did not meet these criteria and was therefore eliminated as a COI. Iron was eliminated as a COI because it is an essential element that has a low toxicity and a screening value that is based on an EPA residential RBSC.

Screening values used for arsenic, cadmium, copper, and mercury are based on their specific area background concentrations, because these background levels exceed MTCA Method B values. Area background concentrations were established during preparation of the OU B RI report. Arsenic detections that exceed the arsenic screening value are shown on Figure 6-5. The maximum concentration of 12.3 mg/kg slightly exceeds the Puget Sound natural background value of 11.6 mg/kg published by Ecology. There does not appear to be a pattern in the distribution of arsenic exceedances. It is possible that arsenic at OU D is from the spent sandblasting grit used in the fill material at the site. It is also possible that arsenic at OU D is from natural background.

Cadmium detections that exceed the cadmium screening value are shown in Figure 6-6. The highest concentration of 7.3 mg/kg was detected in the sample collected from 2 to 5 feet bgs in CL-S02 located immediately east of Building 453. There were no exceedances in the samples surrounding CL-S02. The remaining four cadmium exceedances were collected from PS10E-SB02 and PS10E-SB03 in fill material placed closer to the shoreline.

Chromium detections that exceed the chromium screening value are shown on Figure 6-6. Only the maximum detected value of 805 mg/kg exceeded twice the screening value. The maximum value was detected in the sample from 0 to 2 feet bgs at S-09. The other exceedance was detected in a sample from 0 to 2 feet bgs at PS10E-SB03 located approximately 50 feet from S-09. It is possible that a surface release (i.e., leaching or particulates from materials stored on the ground at the site) may have resulted in the elevated chromium concentrations near S-09 and PS10E-SB03.

Copper detections that exceed the copper screening value are shown in Figure 6-7. Most locations contained at least one sample with concentrations in excess of the screening criteria. In general, the highest concentrations were detected in the shallower samples where samples were collected below the surface soil. There does not appear to be an obvious source or areal pattern to the distribution of copper.

Mercury detections that exceed the mercury screening value are shown in Figure 6-8. The highest concentration of 3.6 mg/kg was detected in the sample collected from 5 to 10 feet bgs in B-04 located near the shoreline in the southeastern area of the site. Mercury concentrations that are greater than 10 times the screening criteria are present in 4 of 7 locations immediately adjacent to Buildings 371 and 453 and in 4 of 10 locations in the filled area of the site nearer the shoreline.

The distribution of zinc exceedances is shown in Figure 6-6. The highest concentration of 2,640 mg/kg was detected in the sample collected from 0 to 2 feet bgs in S-09. The three samples from CL-SO2 contained elevated levels of zinc, suggesting that there may be a localized source adjacent to the Building 453. Other occurrences of zinc appear to be distributed across the site in no apparent pattern.

#### **6.4.5 Total Petroleum Hydrocarbons**

Soil samples were analyzed for three types of TPH, including TPH-gasoline, TPH-diesel, and TPH-heavy oils. Each type of TPH was detected (Table 6-2). TPH-diesel was detected in 1 of 59 samples in excess of its screening value of 2,000 mg/kg. Because the highest TPH-diesel concentration (2,100 mg/kg) was less than twice the screening value and because the number of exceedances is less than 10 percent, TPH-diesel is not a COI.

TPH-heavy oil is a COI, however. Three of 59 samples analyzed for TPH-heavy oils exceeded its screening criteria of 2,000 mg/kg. Detected concentrations ranged from 14 to 5,100 mg/kg, with an average concentration of 731 mg/kg. Figure 6-3 shows the locations and concentrations of the three exceedances. The highest concentration was in a sample collected from 0 to 2 feet bgs in B-1. The other two exceedances were in samples collected from CL-S04, located immediately south of Building 371. This is the same location where elevated cPAHs were detected.

Petroleum contamination is not usually addressed as part of CERCLA cleanup actions. Therefore, TPH was not evaluated in the development of remedial alternatives for OU D.

#### **6.4.6 Summary of Nature and Extent of Contamination**

As a result of chemical screening, the COIs include the following:

- **VOCs:** Tetrachloroethene
- **SVOCs:** Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene (These analytes are collectively referred to as cPAHs.)
- **Pesticides/Aroclors:** 4,4-DDT, dieldrin, and endrin
- **Inorganics:** Arsenic, cadmium, chromium, copper, mercury, and zinc

- **Total Petroleum Hydrocarbons:** TPH-heavy oil (also known as TPH-residual-range organics and TPH-motor oil)

In general, the COIs are not distributed in clear patterns that would be expected of a significant chemical release. The lack of clear patterns of distribution of COIs may be attributed to existing chemicals in the fill material in the southern portion of OU D, to localized releases such as an oil or diesel spill from a vehicle near a building, and to natural background concentrations (inorganics only). PCE was present above its screening value at one location in a sample collected in 1991. The likeliest source is the material used in the fill material. Carcinogenic PAHs were detected at several locations across the site. Two localized petroleum releases adjacent to Building 371 may have caused the cPAH exceedances at these locations, because TPH was also detected in the samples collected there. The inorganic COIs do not exhibit a pattern in their distribution and may be naturally occurring, with a few exceptions. Some of the exceedances of cadmium, chromium, and mercury are likely present because of the material used to fill the southern portion of OU D. Laboratory activities or materials adjacent to Buildings 371 and 453 may have resulted in some of the exceedances of mercury and zinc. TPH-heavy oil is likely the result of localized releases, such as an area adjacent to the south side of Building 371.

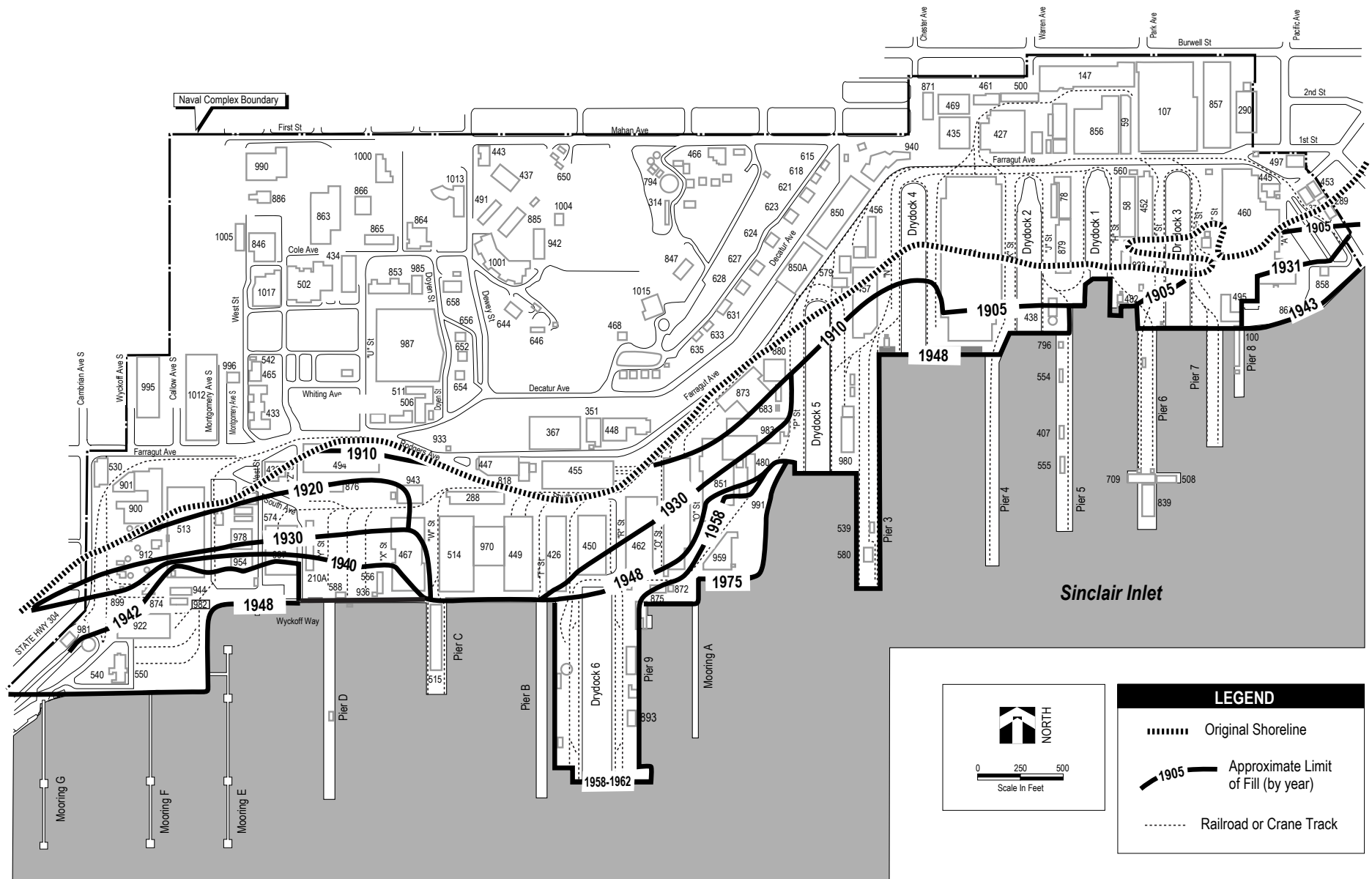
## 6.5 FATE AND TRANSPORT OF KEY CHEMICALS

The primary transport pathway of concern is the soil-to-groundwater-to-surface-water pathway. According to fate and transport evaluations presented in the OU B RI report, the leaching of chemicals from the soil to groundwater, chemical transport in groundwater, and eventual chemical discharge to the surface water should not result in concentrations above water quality criteria. Leaching of COIs from the soil to groundwater is less likely at OU D than at OU B T because COI concentrations in OU D soil are significantly less than concentrations in OU B T soil. However, less than 5 percent of OU B T is unpaved, minimizing infiltration and subsequent leaching of COIs in unsaturated soil to the groundwater. A higher percentage (approximately 50 percent, or 2.5 of 5.3 acres) of OU D is unpaved. Infiltration could be increased in a portion of OU D if the land use changes to recreational and a sprinkler system is installed to support a park setting. Overall, this transport pathway remains an important one that was considered in the FS sections of this ROD.

The transport of stormwater and sediment in the stormwater drainage system is also a pathway of concern that was evaluated. OU D includes stormwater facilities for collecting surface runoff and transporting it to Sinclair Inlet. Catch basins constructed at intervals within the stormwater collection system trap soil particles and other solid material that have entered the stormwater inlets. This helps prevent this material from restricting flow in or ultimately plugging the stormwater lines. Based on experience during cleanup of the stormwater facilities at OU NSC,

many catch basins and the stormwater lines themselves may contain solid material accumulated over many years of facility use. Chemical contamination was commonly found in samples of catch basin sediments collected within OU B T. These sediments can act as a source of contamination since stormwater flowing through the sediment can pick up chemicals in dissolved or particulate form.

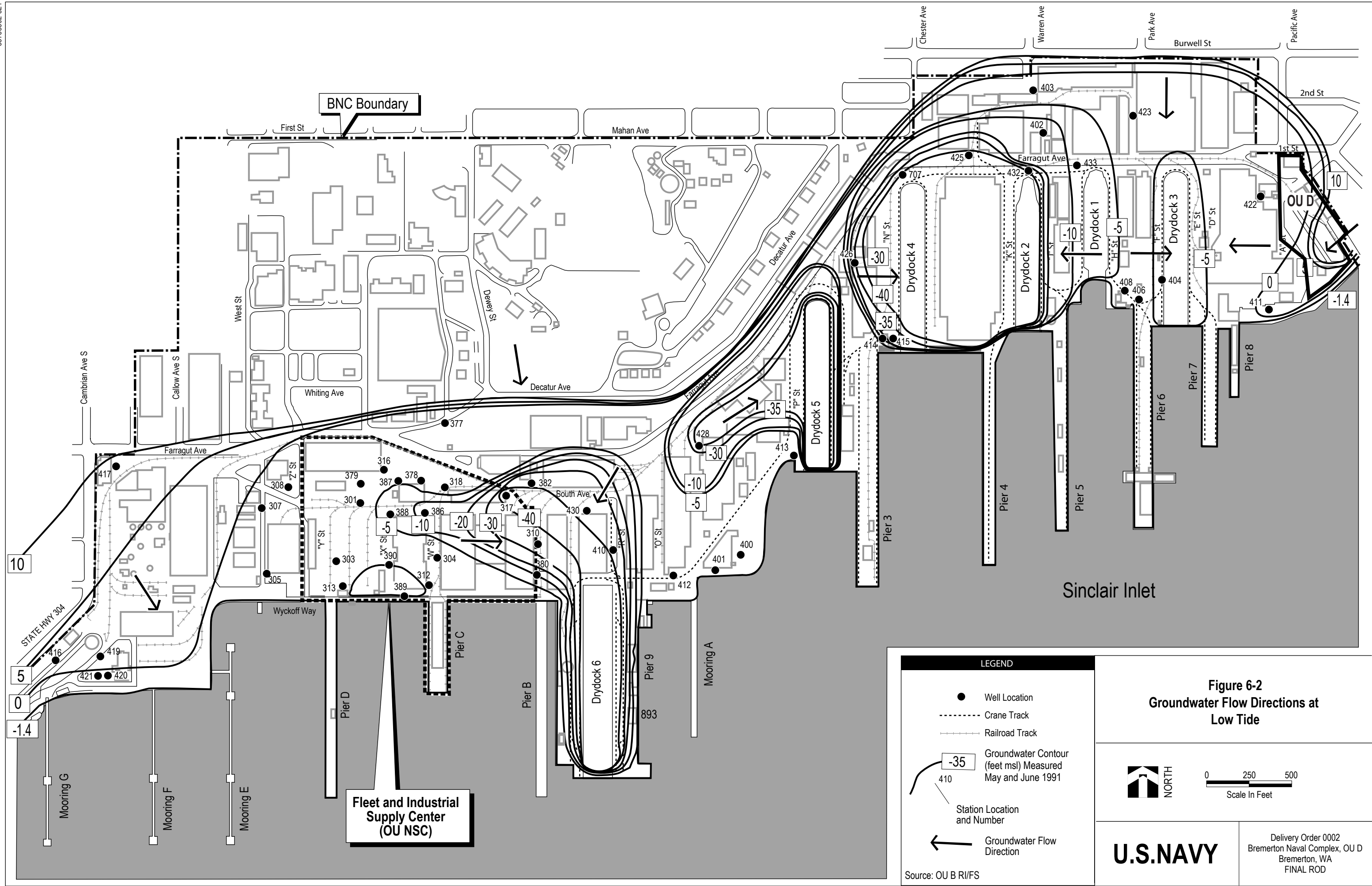
The Navy will clean and repair the stormwater system at OU D as part of the remedial action for OU B T. OU D was part of OU B T when the remedial action for OU B T was selected. Remedial alternatives for OU D incorporate this stormwater element, and it is discussed in Sections 10.3.2 and 10.4 of this ROD.



**U.S.NAVY**

**Figure 6-1**  
**Shoreline Development Within Bremerton Naval Complex**

Delivery Order 0002  
Bremerton Naval Complex, OU D  
Bremerton, WA  
FINAL ROD



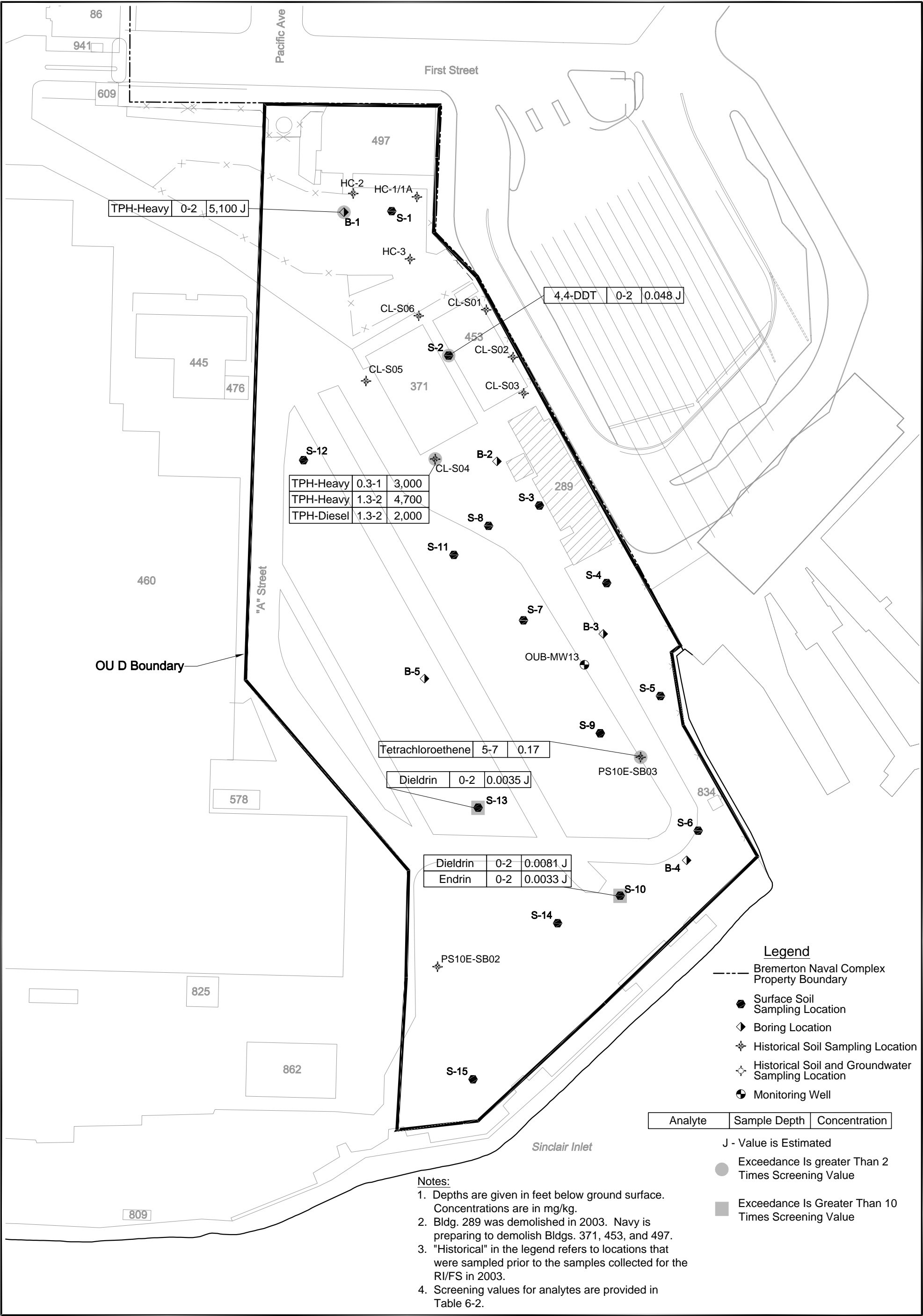
**Figure 6-2**  
**Groundwater Flow Directions at Low Tide**

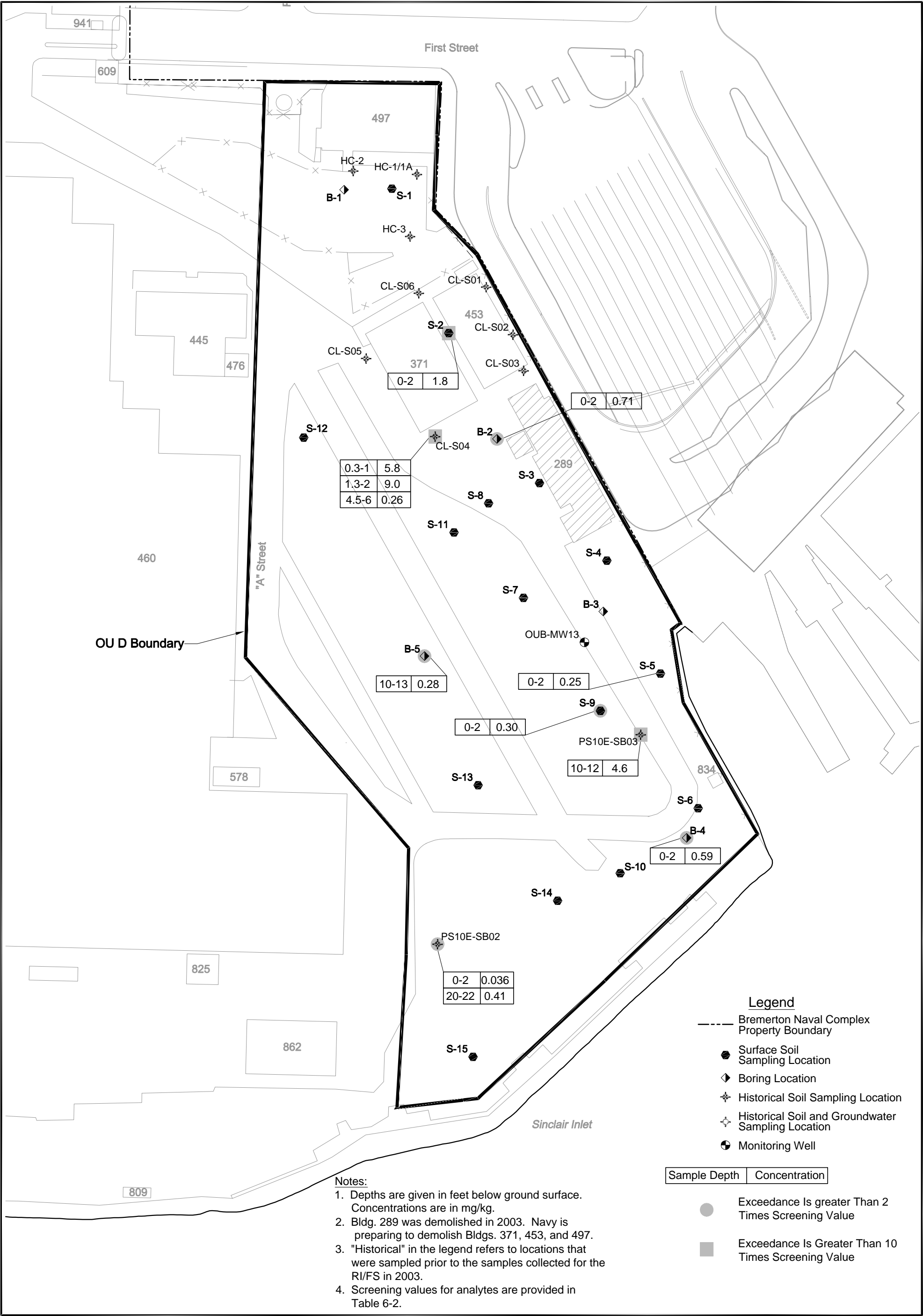


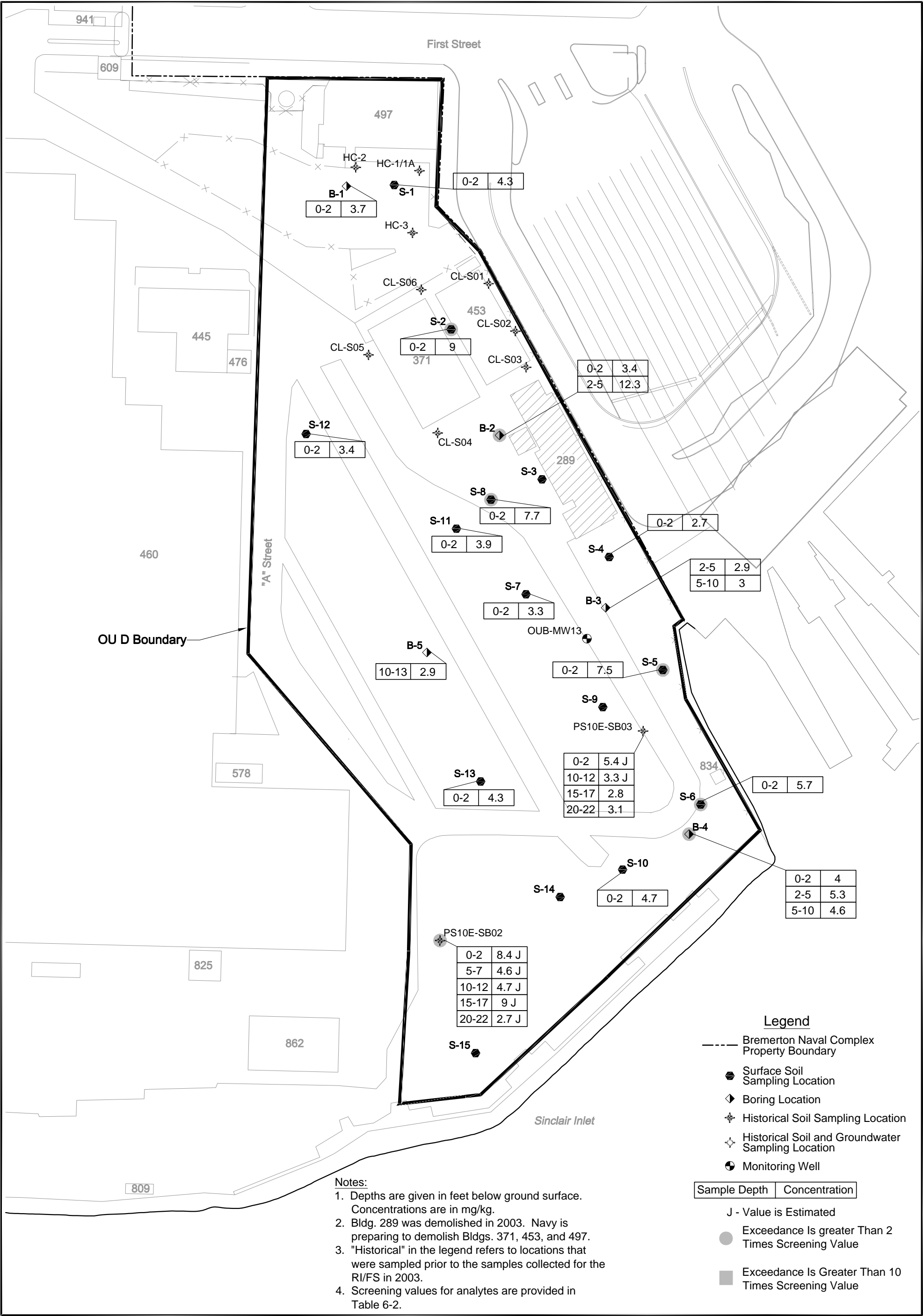
0 250 500  
Scale In Feet

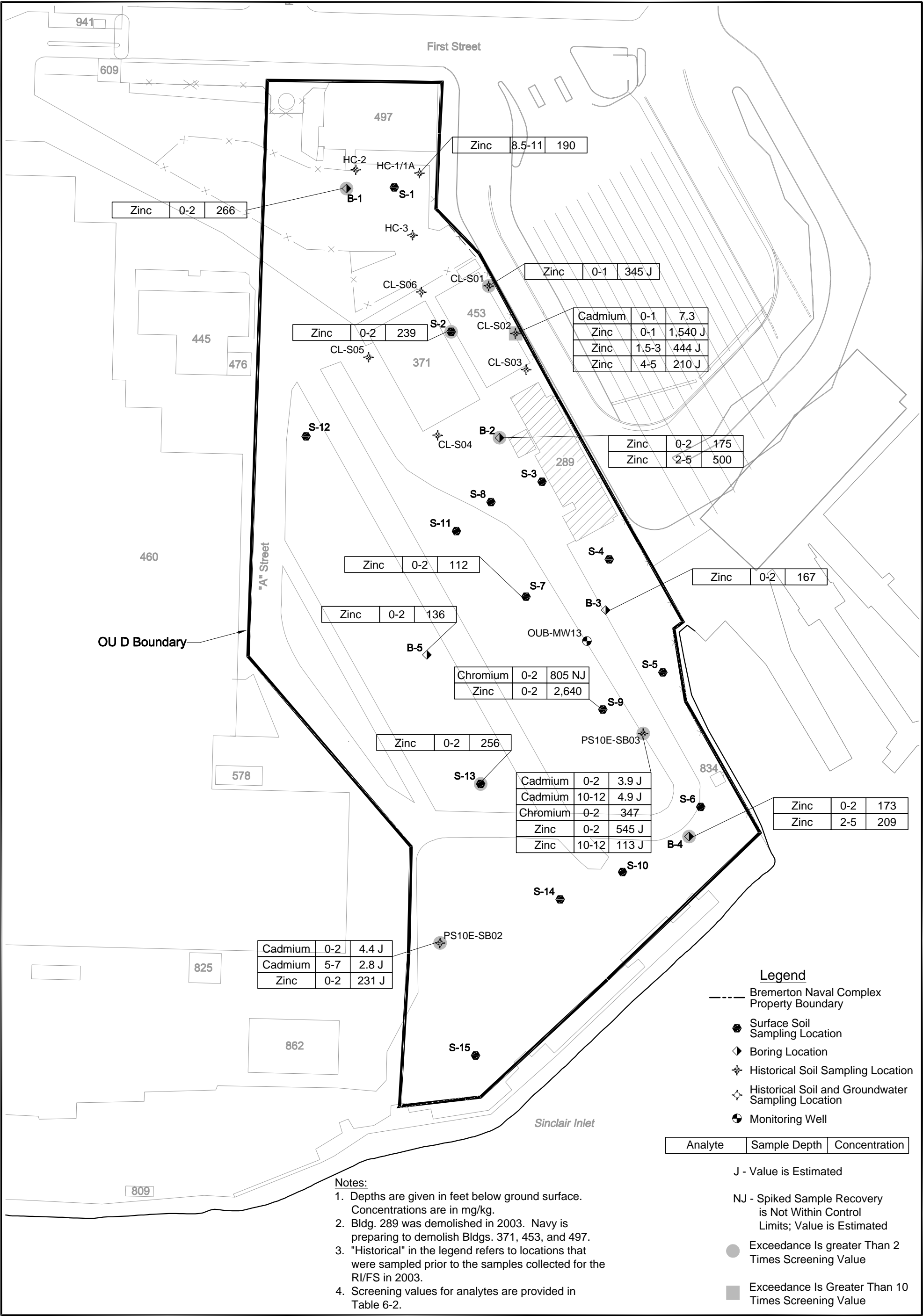
**U.S. NAVY**

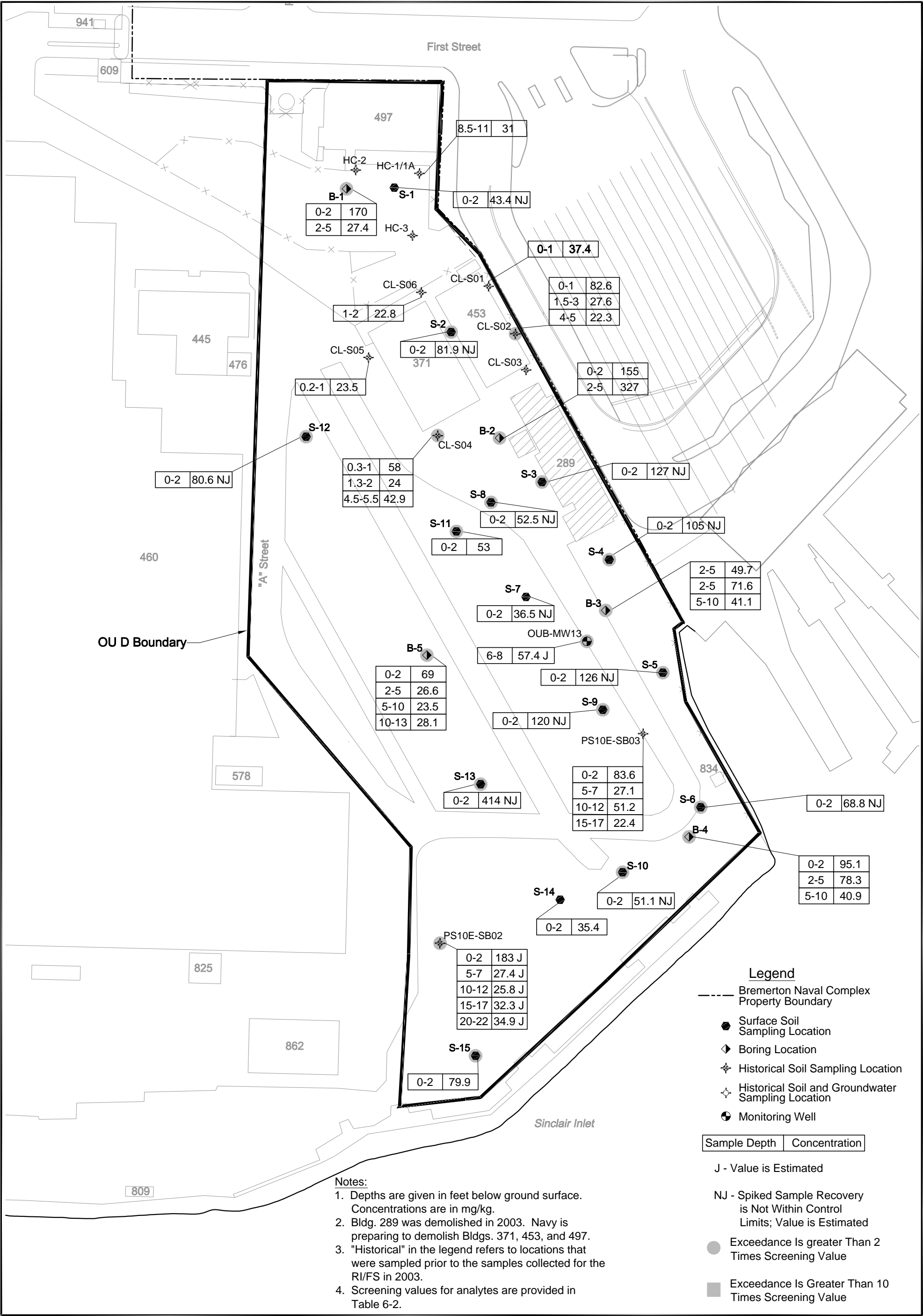
Delivery Order 0002  
Bremerton Naval Complex, OU D  
Bremerton, WA  
FINAL ROD

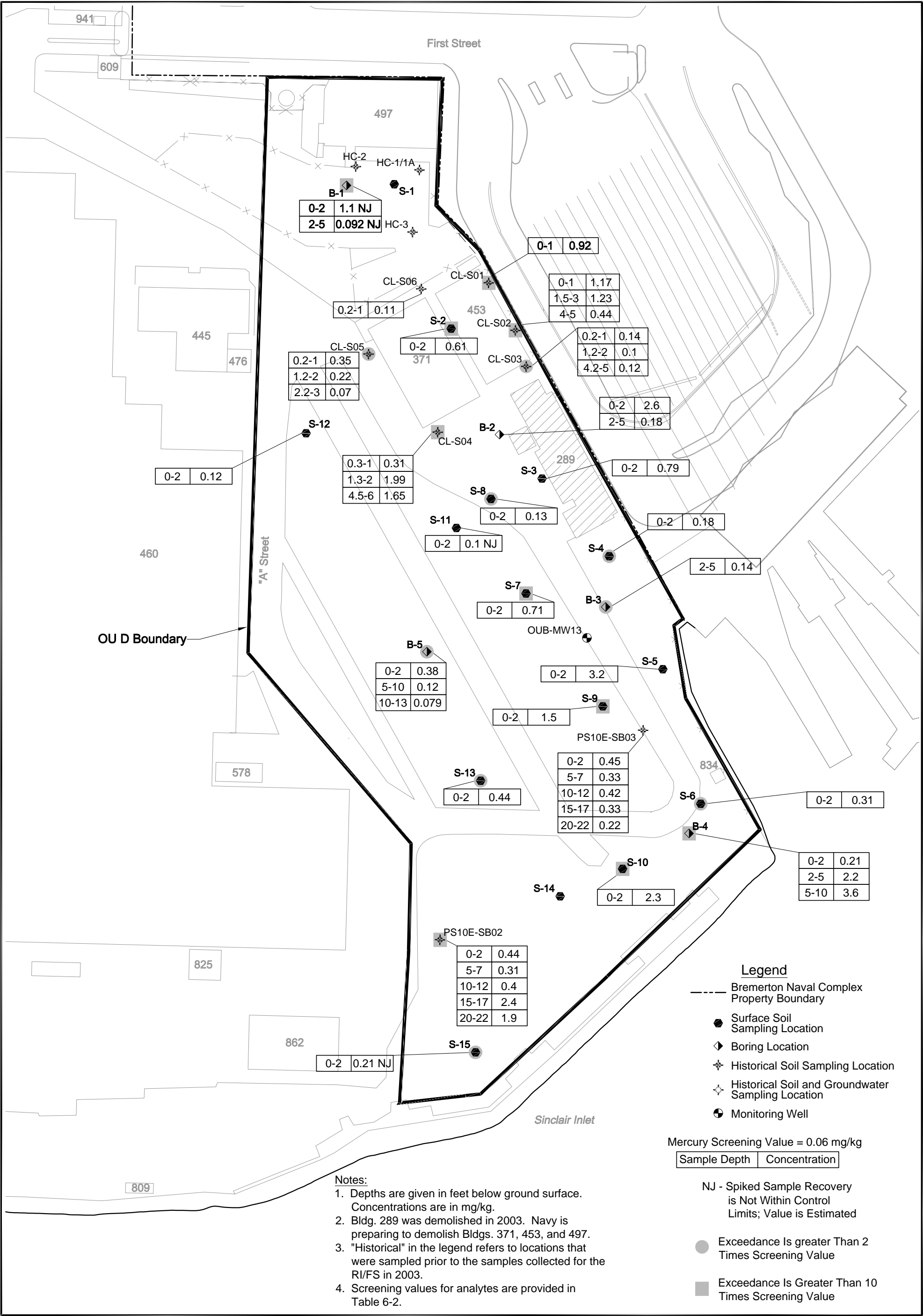












**Table 6-1**  
**Types of Chemical Analyses Performed on OU D Soil Samples**

Location	Beginning Sample Depth (foot)	Ending Sample Depth (foot)	Volatile Organic Compounds	Semivolatile Organic Compounds	Pesticides	PCBs	Inorganics	Limited Inorganics <sup>a</sup>	Total Petroleum Hydrocarbons
HC-1/1A	2	4						X	X
	8.5	10.5						X	X
HC-2	2.5	4						X	X
	7	9						X	X
HC-3	4.5	6.5						X	X
	10.5	11.5						X	X
PS10E-SB02	0	2	X	X	X	X	X		
	5	7	X	X	X	X	X		
	10	12	X	X	X	X	X		
	15	17	X	X	X	X	X		
	20	22	X	X	X	X	X		
	25	27	X	X	X	X	X		
PS10E-SB03	0	2			X	X	X		
	5	7	X		X	X	X		
	10	12		X	X	X	X		
	15	17	X		X	X	X		
	20	22			X	X	X		
OUB-MW13	6	8	X	X	X	X	X		X
CL-S01	0	0.5	X	X		X	X		X
	1	2	X	X		X	X		X
CL-S02	0	0.5	X	X		X	X		X
	1.5	2.5	X	X		X	X		X
	4	5	X	X		X	X		X
CL-S03	0.16	0.66	X	X		X	X		X
	1.16	2.16	X	X		X	X		X
	4.16	5.16	X	X		X	X		X

**Table 6-1 (Continued)**  
**Types of Chemical Analyses Performed on OU D Soil Samples**

Location	Beginning Sample Depth (foot)	Ending Sample Depth (foot)	Volatile Organic Compounds	Semivolatile Organic Compounds	Pesticides	PCBs	Inorganics	Limited Inorganics <sup>a</sup>	Total Petroleum Hydrocarbons
CL-S04	0.3	0.83	X	X		X	X		X
	1.33	2.33	X	X		X	X		X
	4.5	5.5	X	X		X	X		X
CL-S05	0.16	0.66	X	X		X	X		X
	1.16	2.16	X	X		X	X		X
	2.16	3.16	X	X		X	X		X
CL-S06	0.16	0.66	X	X		X	X		X
	1	2	X	X		X	X		X
	2	2.5	X	X		X	X		X
CL-S07 (dup of S04)	4.5	5.5	X	X		X	X		X
B-01	0	2	X	X	X	X	X		X
	2	5	X	X	X	X	X		X
	5	10	X	X	X	X	X		X
	10	15	X	X	X	X	X		X
B-02	0	2	X	X	X	X	X		X
	2	5	X	X	X	X	X		X
	5	10	X	X	X	X	X		X
B-03	0	2	X	X	X	X	X		X
	2	5	X	X	X	X	X		X
	5	10	X	X	X	X	X		X
B-04	0	2	X	X	X	X	X		X
	2	5	X	X	X	X	X		X
	5	10	X	X	X	X	X		X
B-05	0	2	X	X	X	X	X		X
	2	5	X	X	X	X	X		X
	5	10	X	X	X	X	X		X
	10	15	X	X	X	X	X		X

**Table 6-1 (Continued)**  
**Types of Chemical Analyses Performed on OU D Soil Samples**

Location	Beginning Sample Depth (foot)	Ending Sample Depth (foot)	Volatile Organic Compounds	Semivolatile Organic Compounds	Pesticides	PCBs	Inorganics	Limited Inorganics <sup>a</sup>	Total Petroleum Hydrocarbons
S-1	0	2	X	X	X	X	X		X
S-2	0	2	X	X	X	X	X		X
S-3	0	2	X	X	X	X	X		X
S-4	0	2	X	X	X	X	X		X
S-5	0	2	X	X	X	X	X		X
S-6	0	2	X	X	X	X	X		X
S-7	0	2	X	X	X	X	X		X
S-8	0	2	X	X	X	X	X		X
S-9	0	2	X	X	X	X	X		X
S-10	0	2	X	X	X	X	X		X
S-11	0	2	X	X	X	X	X		X
S-12	0	2	X	X	X	X	X		X
S-13	0	2	X	X	X	X	X		X
S-14	0	2	X	X	X	X	X		X
S-15	0	2	X	X	X	X	X		X

<sup>a</sup>Limited inorganics includes cadmium, copper, lead, and zinc.

Notes:

dup. - duplicate

PCBs - polychlorinated biphenyls

X indicates that the sample from the specified location was analyzed for the compound group identified in the column heading

**Table 6-2**  
**Selection of Chemicals of Interest in Soil**

Analyte	Number Tested	Number Detected	Minimum Detected Value (mg/kg)	Maximum Detected Value (mg/kg)	Average Detected Value (mg/kg)	UCL95 (mg/kg)	RME (mg/kg)	Screening Value (mg/kg)	Number Exceeding Screening Value	Screening Value Source	10% of Number Tested Exceeds Screening Value?	Max. Conc. in Excess of Twice Screening Value?	UCL95 Exceeds Screening Value?	Retain or Eliminate As COI?
<b>Volatile Organic/Compounds</b>														
BTEX (total)	9	2	0.039	0.111	0.075	0.042	0.042	See Note a	NA	NA	NA	NA	NA	Eliminate
Xylenes (total)	9	2	0.009	0.044	0.0265	0.0171	0.0171	See Note a	NA	NA	NA	NA	NA	Eliminate
Ethylbenzene	59	6	0.0007	0.01	0.00287	0.00239	0.00239	74.1	0	MTCA Method B Soil/SW	NA	NA	NA	Eliminate
Styrene	59	1	0.008	0.008	0.008	0.00232	0.00232	33.3	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
1,3,5-Trimethylbenzene	50	1	0.0009	0.0009	0.0009	0.00188	0.0009	21.3	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Toluene	59	18	0.0005	0.057	0.00749	0.00565	0.00565	422	0	MTCA Method B Soil/SW	NA	NA	NA	Eliminate
Tetrachloroethene	59	5	0.0019	0.17	0.0385	0.00978	0.00978	0.0552	1	MTCA Method B Soil/SW	No	Yes	No	Retain
Xylenes	27	9	0.0012	0.044	0.00872	0.00687	0.00687	160000	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
1,2-Dichloroethene	9	1	0.001	0.001	0.001	0.00703	0.001	720	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Acetone	59	15	0.0079	0.12	0.0338	0.0175	0.0175	8000	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Methylene chloride	59	5	0.002	0.003	0.0022	0.00265	0.00265	4.28	0	MTCA Method B Soil/SW	NA	NA	NA	Eliminate
Carbon disulfide	59	2	0.001	0.003	0.002	0.00254	0.00254	8000	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Trichlorofluoromethane	50	11	0.003	0.013	0.00409	0.00244	0.00244	24000	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
2-Butanone	59	4	0.004	0.011	0.0085	0.00765	0.00765	48000	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Trichloroethene	59	1	0.015	0.015	0.015	0.00286	0.00286	0.421	0	MTCA Method B Soil/SW	NA	NA	NA	Eliminate
o-Xylene	50	6	0.0007	0.0058	0.00192	0.00205	0.00205	160000	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
1,2,4-Trimethylbenzene	50	10	0.0006	0.003	0.00106	0.00196	0.00196	51.6	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
<b>Semivolatile Organics/Compounds</b>														
cPAH (total)	8	4	0.222	18.3	5.26	6.95	6.95	See Note a	NA	NA	NA	NA	NA	Eliminate
HPAH (total)	8	5	0.151	31.7	7.26	12	12	See Note a	NA	NA	NA	NA	NA	Eliminate
LPAH (total)	8	3	0.16	14.153	4.9	5.25	5.25	See Note a	NA	NA	NA	NA	NA	Eliminate
Benzo(a)fluoranthene (total)	8	4	0.172	7.6	2.26	2.94	2.94	See Note a	NA	NA	NA	NA	NA	Eliminate
bis(2-Ethylhexyl)phthalate	58	11	0.05	2.4	0.609	0.4	0.4	12.0	0	MTCA Method B Soil/SW	NA	NA	NA	Eliminate
Anthracene	58	25	0.004	3.3	0.42	0.35	0.35	18479	0	MTCA Method B Soil/SW	NA	NA	NA	Eliminate
Pyrene	58	39	0.009	9.9	0.99	1.11	1.11	2400	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Dibenzofuran	58	7	0.11	0.34	0.217	0.166	0.166	291	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Benzo(g,h,i)perylene	58	32	0.007	2.5	0.285	0.274	0.274	NA	NA	NA	NA	NA	NA	Eliminate
Indeno(1,2,3-cd)pyrene	58	29	0.006	2.9	0.291	0.27	0.27	0.137	8	MTCA Method B Soil Unrestricted	Yes	Yes	Yes	Retain
Benzo(b)fluoranthene	58	32	0.004	6.7	0.582	0.584	0.584	0.137	12	MTCA Method B Soil Unrestricted	Yes	Yes	Yes	Retain
Fluoranthene	58	38	0.007	9	0.777	0.894	0.894	134	0	MTCA Method B Soil/SW	NA	NA	NA	Eliminate
Benzo(k)fluoranthene	58	29	0.004	3.8	0.436	0.397	0.397	0.137	11	MTCA Method B Soil Unrestricted	Yes	Yes	Yes	Retain
Acenaphthylene	58	4	0.009	0.043	0.0193	0.048	0.043	10000	0	MTCA Method A Unrestricted	NA	NA	NA	Eliminate
Chrysene	58	35	0.005	5.1	0.486	0.519	0.519	0.137	12	MTCA Method B Soil Unrestricted	Yes	Yes	Yes	Retain
Benzo(a)pyrene	58	32	0.004	6.8	0.587	0.591	0.591	0.137	11	MTCA Method B Soil Unrestricted	Yes	Yes	Yes	Retain
Dibenz(a,h)anthracene	58	6	0.015	0.62	0.281	0.0887	0.0887	0.137	4	MTCA Method B Soil Unrestricted	No	Yes	No	Retain
4,6-Dinitro-2-methylphenol	58	1	0.25	0.25	0.25	0.42	0.25	NA	NA	NA	NA	NA	NA	Eliminate
Benzo(a)anthracene	58	35	0.004	5.8	0.491	0.539	0.539	0.137	11	MTCA Method B Soil Unrestricted	Yes	Yes	Yes	Retain
Benzoic acid	57	21	0.32	0.67	0.379	0.524	0.524	320000	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Acenaphthene	58	17	0.005	1.8	0.369	0.217	0.217	98	0	MTCA Method B Soil/SW	NA	NA	NA	Eliminate
Diethylphthalate	58	2	0.1	0.12	0.11	0.164	0.12	184	0	MTCA Method B Soil/SW	NA	NA	NA	Eliminate
Phenanthrene	58	36	0.005	9.8	1.1	1.19	1.19	NA	NA	NA	NA	NA	NA	Eliminate
Butylbenzylphthalate	58	3	0.034	0.11	0.078	0.161	0.11	524	0	MTCA Method B Soil/SW	NA	NA	NA	Eliminate
Fluorene	58	19	0.004	1.6	0.275	0.187	0.187	819	0	MTCA Method B Soil/SW	NA	NA	NA	Eliminate
Carbazole	51	5	0.15	0.83	0.414	0.196	0.196	50	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Naphthalene	58	24	0.004	0.59	0.102	0.104	0.104	198	0	MTCA Method B Soil/SW	NA	NA	NA	Eliminate
2-Methylnaphthalene	58	6	0.23	0.64	0.407	0.195	0.195	NA	NA	NA	NA	NA	NA	Eliminate

**Table 6-2 (Continued)**  
**Selection of Chemicals of Interest in Soil**

Analyte	Number Tested	Number Detected	Minimum Detected Value (mg/kg)	Maximum Detected Value (mg/kg)	Average Detected Value (mg/kg)	UCL95 (mg/kg)	RME (mg/kg)	Screening Value (mg/kg)	Number Exceeding Screening Value	Screening Value Source	10% of Number Tested Exceeds Screening Value?	Max. Conc. in Excess of Twice Screening Value?	UCL95 Exceeds Screening Value?	Retain or Eliminate As COI?
<b>Pesticides/PCBs</b>														
4,4-DDT	33	4	0.0026	0.048	0.0147	0.00575	0.00575	0.00729	1	MTCA Method B Soil/SW	No	Yes	No	Retain
Aroclor 1260	62	9	0.028	1.2	0.214	0.0911	0.0911	1.00	1	RBSC Residential	No	No	No	Eliminate
Aroclor 1254	62	3	0.19	0.27	0.22	0.051	0.051	1.60	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Dieldrin	33	2	0.0035	0.0081	0.0058	0.00238	0.00238	0.0000672	2	MTCA Method B Soil/SW	No	Yes	Yes	Retain
Endrin	33	1	0.0033	0.0033	0.0033	0.00194	0.00194	0.000760	1	MTCA Method B Soil/SW	No	Yes	Yes	Retain
Endrin ketone	33	4	0.0018	0.006	0.0043	0.00242	0.00242	NA	NA	NA	NA	NA	NA	Eliminate
Endosulfan II	33	3	0.0028	0.011	0.00753	0.00293	0.00293	NA	NA	NA	NA	NA	NA	Eliminate
Endosulfan sulfate	33	1	0.0093	0.0093	0.0093	0.00243	0.00243	NA	NA	NA	NA	NA	NA	Eliminate
Methoxychlor	33	1	0.018	0.018	0.018	0.00998	0.00998	20.2	0	MTCA Method B Soil/SW	NA	NA	NA	Eliminate
PCBs (total)	12	1	1.2	1.2	1.2	0.387	0.387	1.00	1	RBSC Residential	No	No	No	Eliminate
<b>Inorganics</b>														
Aluminum	12	12	6590	18200	12000	14100	14100	76100	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Antimony	40	6	3.3	5.8	4.7	1.33	1.33	32.0	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Arsenic	62	44	1.1	12.3	3.73	3.7	3.7	2.64	29	Area Background	Yes	Yes	Yes	Retain
Barium	62	62	14.2	362	63.2	73.7	73.7	5600	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Beryllium	44	30	0.04	0.29	0.142	0.158	0.158	160	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Cadmium	70	21	0.1	7.3	1.86	0.874	0.874	2.30	5	Area Background	No	Yes	No	Retain
Calcium	12	12	4420	25800	9370	12700	12700	NA	NA	NA	NA	NA	NA	Eliminate
Chromium	62	62	9.2	805	52.3	75	75	210	2	RBSC Residential	No	Yes	No	Retain
Cobalt	12	12	4.7	13.7	8.6	10.1	10.1	903	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Copper	70	70	4.3	414	54.4	68.1	68.1	21.7	49	Area Background	Yes	Yes	Yes	Retain
Iron	12	12	9420	34700	19200	23300	23300	23500	3	RBSC Residential	Yes	No	No	Eliminate
Lead	70	64	0.95	819	78.2	96	96	1650	0	MTCA Method B Soil/SW	NA	NA	NA	Eliminate
Magnesium	12	12	3210	7340	5580	6290	6290	NA	NA	NA	NA	NA	NA	Eliminate
Manganese	12	12	137	409	255	301	301	11200	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Mercury	62	56	0.002	3.6	0.681	0.8	0.8	0.0600	49	Area Background	Yes	Yes	Yes	Retain
Nickel	62	62	10.3	151	36.2	40.3	40.3	NA	NA	NA	NA	NA	NA	Eliminate
Potassium	12	11	521	2200	844	1040	1040	NA	NA	NA	NA	NA	NA	Eliminate
Silver	62	9	0.2	1.8	0.799	0.379	0.379	1.03	2	Area Background	No	No	No	Eliminate
Sodium	12	12	259	2830	1100	1510	1510	NA	NA	NA	NA	NA	NA	Eliminate
Selenium	62	32	0.32	7.2	1.69	1.72	1.72	7.38	0	MTCA Method B Soil/SW	NA	NA	NA	Eliminate
Thallium	44	32	0.23	7.4	2.9	2.57	2.57	5.60	1	MTCA Method B Soil Unrestricted	No	No	No	Eliminate
Vanadium	12	12	25.8	61.2	43.1	49.4	49.4	560	0	MTCA Method B Soil Unrestricted	NA	NA	NA	Eliminate
Zinc	70	70	10.9	2640	158	231	231	101	21	MTCA Method B Soil/SW	Yes	Yes	Yes	Retain
<b>Total Petroleum Hydrocarbons</b>														
TPH-Diesel	59	34	3.7	2100	146	151	151	2000	1	MTCA Method A Unrestricted	No	No	No	Eliminate
TPH-Heavy Fraction/Oil	59	36	14	5100	731	673	673	2000	3	MTCA Method A Unrestricted	No	Yes	No	Retain
TPH-Gasoline	59	2	5.6	6.4	6	3.44	3.44	100	0	MTCA Method A Unrestricted	NA	NA	NA	Eliminate

<sup>a</sup>See individual analytes for screening value.

Notes:  
 Shaded analytes are retained as chemicals of interest (COIs).  
 BTEX - benzene, toluene, ethylbenzene, and xylenes  
 cPAH - carcinogenic polycyclic aromatic hydrocarbons  
 HPAH - high-molecular-weight polycyclic aromatic hydrocarbons  
 LPAH - low-molecular-weight polycyclic aromatic hydrocarbons

Max. Conc. - maximum concentration  
 MTCA - Model Toxics Control Act  
 NA - not available or not applicable  
 RME - reasonable maximum exposure  
 TPH - total petroleum hydrocarbons

UCL95 - 95 percent upper confidence limit  
 mg/kg - milligram per kilogram

## **7.0 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES**

### **7.1 LAND USE**

BNC, a federal facility including PSNS & IMF and NBK at Bremerton, is situated along the south edge of the City of Bremerton. The current land use for OU D, located within PSNS & IMF is characterized as heavy industrial. The primary role of PSNS & IMF is to provide overhaul, maintenance, conversion, refueling, defueling, and repair services to the naval fleet. Six large drydocks are regularly used to service all classes of Navy vessels. The buildings and land within OU D have served to support the primary roles of PSNS & IMF and NBK at Bremerton.

The Navy is considering transferring a majority of OU D to the City of Bremerton for recreational use. The Navy intends to retain a 20-foot-wide strip of land along the western border of OU D to serve as a buffer along the Navy fence line.

### **7.2 RESOURCE USES**

#### **7.2.1 Groundwater**

There is no current beneficial use of groundwater at BNC, and no use is anticipated in the future. Data collected during the SI and RI indicate that the groundwater at BNC is not a potable water source. Intruding seawater mixes with the groundwater and produces a brackish mixture throughout most of the low-lying shoreline area at BNC. In addition, observations during sampling suggest that water cannot be withdrawn from site wells in sufficient quantity and condition to sustain a viable drinking water source. In accordance with EPA guidance (55 FR 8732, March 8, 1990), groundwater at OU D is considered a Class III groundwater because of high salinity due to marine water intrusion and thus is unsuitable for human consumption. BNC obtains water from the City of Bremerton's municipal water system.

#### **7.2.2 Surface Water**

There are no natural surface water bodies within OU D. The shoreline immediately adjacent to OU D is part of OU B T. Precipitation and stormwater runoff from paved areas are captured in the stormwater system and discharged to Sinclair Inlet. Some precipitation over unpaved areas can infiltrate through the soil to the shallow groundwater.

### **7.2.3 Other Natural Resources**

Because of the industrialized nature of the site, there are no other natural resources such as forests or streams. Only minimal vegetation is present and was installed in 1998 as part of a removal action at OU D.

## **8.0 SUMMARY OF SITE RISKS**

The baseline risk assessment for the originally defined OU D estimated the risks that could exist based on taking no remedial actions, considering both current and potential future land use. The risk assessment included evaluations of human health. No ecological risk assessment was conducted because there is no terrestrial habitat.

Analytical data used to evaluate human health risk were based on samples collected across the originally defined OU D. The risk assessment was completed before the OU D boundaries were redefined; therefore, this section refers to the originally defined OU D.

### **8.1 HUMAN HEALTH RISK ASSESSMENT**

The baseline human health risk assessment (HHRA) for OU D provides a quantitative and qualitative evaluation of potential risk to humans from contact with chemicals identified. Data collected throughout OU D and some data collected adjacent to OU D were combined into a single database for use in this site-wide HHRA.

#### **8.1.1 Chemical Selection Process**

Typically, not all chemicals present at a site pose health risks or contribute significantly to overall site risks. EPA guidelines recommend focusing on a group of chemicals of potential concern (COPCs) based on inherent toxicity, site concentration, and behavior of the chemicals in the environment. To identify these COPCs, risk-based screening values are compared to site concentrations of chemicals. If site concentrations of a chemical exceed their respective screening concentrations, then further evaluation of their concentrations is conducted and the chemicals may be retained as COPCs for further evaluation in the risk assessment. EPA Region 9 residential and industrial soil preliminary remediation goals (PRGs) and tap water PRGs were used as the risk-based screening values in the COPC screening process. For chemicals without screening criteria, screening criteria for surrogate chemicals were used wherever possible.

COPCs were selected for impacted media at the site (Table 8-1). The screening process consisted of the steps listed below. Note that a different, albeit similar, screening process was used as described in Section 6.4 to select chemicals of interest for the purposes of nature and extent. As stated above, the purpose of this screening is to identify COPCs for the purposes of human health risk assessment.

1. **Determination of the frequency of chemical detection.** The 1989 EPA guidance document titled *Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual* allows the elimination of chemicals from the quantitative evaluation if they are detected infrequently and the magnitude of exceedance is not a concern. In this assessment, a frequency of detection of 5 percent was used as a criterion for the elimination of chemicals as COPCs. In other words, if a chemical was detected in fewer than 5 percent of the samples for a particular medium, it was eliminated as a COPC if the magnitude of exceedance was not a concern. It should be noted that for data sets containing fewer than 20 samples, evaluation of the frequency of detection is generally not applicable. Some chemicals in soil and all chemicals in groundwater had fewer than 20 samples.
2. **Comparison of maximum detected chemical concentrations to background.** The term “background” is used here to refer to chemical concentrations that would be expected to occur naturally in the environment without influence from humans. In general, comparison with natural background levels is applicable only to inorganic contaminants because the majority of organic contaminants are not naturally occurring. Background values for all VOCs, SVOCs, and TPHs are assumed to be zero in this assessment. Background values for metals are site-specific values for BNC.
3. **Comparison of the maximum detected chemical concentration in a particular medium to the screening value.** If the maximum detected chemical concentration exceeds the screening value, then the chemical is tentatively selected for further evaluation in the risk assessment. For this evaluation, surface soil (defined as 0 to 2 feet) concentrations were screened separately from the rest of the soil data using residential PRGs because of the future land use for the site may become recreational (i.e., a public park). In addition, all soil data (0 to 15 feet) were screened using industrial PRGs because the potential for construction workers to be exposed to soils up to 15 feet below ground surface. One-tenth of PRGs for noncarcinogenic compounds and the full PRG for carcinogenic compounds were used for screening per EPA guidance.

In this step of the screening process, all chemicals with a maximum concentration exceeding a screening value are identified. The rationale behind comparing the maximum concentration against one-tenth of a risk-based value (noncarcinogens) is explained by the default assumption that all toxic effects are additive. For example, two or more chemicals that are present at concentrations just below the

levels of concern for the individual chemicals could be a health concern if their toxic effects are considered additive. Thus, it is important to select more, rather than fewer, chemicals to evaluate in the risk assessment due to potential cumulative effects. However, in some cases an exceedance of the screening value by a maximum concentration does not represent either an individual or an additive health concern within the context of a particular site, and, consequently, the chemical can be safely eliminated as a COPC and not affect the outcome of the risk assessment. The following two steps describe the process used to further evaluate the chemicals with maximum concentrations that exceed the screening level.

4. **Evaluation of the frequency of exceedance over screening levels.** The frequency of exceedance of concentrations above the screening level was also evaluated. Estimates of risk are calculated using the 95 percent upper confidence limit (UCL95) of the mean concentration for each chemical because the risk calculations are based on an estimate of average exposure concentration over time, not the maximum concentration. Therefore, if only a handful of concentrations of a chemical exceed a screening level, and the magnitude of exceedance is not large, the chemical will not represent a health risk and can potentially be eliminated from the risk evaluation, particularly if the screening level is below a level that is a health concern. Chemicals with few concentrations exceeding their screening levels, especially those with screening levels below risk-based levels, may be eliminated from further evaluation. In general, a frequency of exceedance of 10 percent or less was considered acceptable, thus warranting exclusion as a COPC.
5. **Evaluation of the magnitude of exceedance over screening levels.** If the frequency of exceedance was 10 percent or less, then the magnitude of exceedance was evaluated (note that this is different than the 5 percent frequency of detection screening step). A magnitude of exceedance of up to 10 times the screening level was considered a potentially acceptable reason for exclusion as a COPC if the screening level was one-tenth of a risk-based value. However, exclusion as a COPC based on frequency and magnitude of exceedance are evaluated on a case-by-case basis depending on the toxicity of the chemical, the specific screening level, and the magnitude of exceedances.

### 8.1.2 Exposure Assessment

The purpose of the exposure assessment is to identify human receptors potentially at risk and estimate the type and magnitude of exposures to the COPCs identified at the site. The results of

the exposure assessment are combined with chemical-specific toxicity information to characterize potential risks.

The exposure assessment process involves four steps: (1) characterizing the exposure setting, (2) identifying exposure pathways, (3) calculating exposure point concentrations (EPCs), and (4) quantifying exposure in the form of chemical intakes.

The exposure setting for OU D is based on current and hypothetical future land uses at the site. The population of concern under current conditions is the adult construction worker. For future conditions, the populations of concern include the adult construction worker and child and adult park visitors and recreational populations. No residential populations would be exposed to chemicals at the site. Construction workers potentially disturbing soil in the course of construction activity could be exposed through incidental ingestion, dermal contact, and inhalation of chemicals in soil. Recreational visitors to the park could potentially be exposed through incidental ingestion, dermal contact, and inhalation of chemicals in surface soil.

Groundwater is not a drinking water source; therefore, the only potentially complete exposure pathways would be dermal contact by construction workers and inhalation of vapors emanating from groundwater by both construction workers and recreational visitors. For the construction worker, dermal contact was evaluated as part of the OU B T human health risk assessment, and risks associated with this pathway were acceptable (below EPA's risk range). Dermal contact and inhalation of vapors emanating from groundwater by both construction workers and recreational visitors at OU D were found to be incomplete pathways. No SVOCs were detected in the vicinity of OU D above screening levels in groundwater (i.e., incomplete dermal pathway). Additionally, inhalation exposure pathways were found to be incomplete for both indoor and outdoor inhalation exposure because no VOCs were detected in the vicinity of OU D.

EPCs are concentrations of individual chemicals to which an individual may potentially be exposed for each medium. EPCs were developed based on EPA guidance using data collected at the site. A summary of EPCs is given in Table 8-2.

To calculate chemical doses for each chemical, reasonable maximum exposure (RME) point values and central tendency (CT) values were used. RMEs are intended to provide a conservative estimate of chemical exposure, well above the average potential exposure but within the range of possible exposures. RMEs represent the highest exposures reasonably expected to occur at a site. CT estimates are provided to indicate the range in uncertainty for possible exposures, rather than presenting only one upper-bound estimate. The formulas and exposure factors that were used together with the EPCs to quantify dose for the complete

pathways at the site are presented in Tables 8-3 and 8-4, which also indicate the source of the factors.

### **8.1.3 Toxicity Assessment**

The toxicity assessment involves the following:

- Hazard identification, which weighs the available evidence of the potential adverse effects of chemicals on exposed individuals
- Dose-response assessment, which estimates the relationship between the magnitude of exposure to chemicals and the likelihood or severity of adverse effects

The primary component of hazard identification is the assembling of a toxicological summary consisting of toxicity profiles for the COPCs for the site. These profiles include chemical-specific information regarding the potential for exposure, pharmacokinetics, critical health effects, and the relationship of these effects to chemical exposures. Tables 8-5 and 8-6 present carcinogenic and noncarcinogenic toxicity criteria used in this risk assessment.

The dose-response assessment is intended to quantify the correlation between the magnitude of chemical exposure and potential resulting adverse health effects. This typically involves analyses of the severity or frequency of adverse effects and the exposure levels at which these effects occur using information from the toxicological literature. The objective of the analyses is to define dose-response relationships for oral ingestion, inhalation, and dermal contact.

The results of dose-response analyses take the form of toxicity values known as reference doses (RfDs) for noncarcinogenic (noncancer) effects and cancer slope factors (CSFs) for carcinogenic (cancer) effects. Some chemicals can produce both cancer and noncancer effects. Toxicity values are available for the ingestion pathway for many chemicals and are available for the inhalation pathway for some chemicals, but are not typically available for the dermal exposure pathway. Dermal toxicity values were derived from oral ingestion toxicity values based on EPA guidelines.

Noncancer effects are defined as all health effects other than cancer. For most noncancer effects, a mechanism is believed to exist that protects an exposed individual from adverse effects until a threshold level of exposure is reached. Laboratory studies are commonly used to gain insight on threshold values for specific chemicals. Although the ultimate objective of such studies is to establish the safe dose for a human, most such studies are carried out on laboratory animals. The

results are commonly extrapolated to humans using conservative uncertainty factors to allow for influences, such as individual variations in response to chemicals, together with modifying factors based on the perceived quality of the toxicological database for a given chemical.

RfDs were obtained in most cases from the EPA's Integrated Risk Information System (IRIS) database. In those cases where the IRIS database does not include RfDs for a particular chemical, values were obtained from the EPA's Health Effects Assessment Summary Tables (HEAST).

The mechanisms leading to the development of cancer are believed to differ from the mechanisms of noncancer effects. No safe threshold level is believed to exist for exposure to cancer-causing chemicals, so a different form of toxicity value is associated with cancer effects. The cancer SF (expressed as milligrams per kilogram per day [mg/kg-day]<sup>-1</sup>) expresses excess cancer risk as a function of dose. The dose-response model is based on high- to low-dose extrapolation, and assumes that there is no lower threshold for the initiation of toxic effects (i.e., exposure to even a miniscule amount of carcinogen is assumed to provide the potential to initiate cancer processes in the body). Specifically, cancer effects observed at high doses in laboratory animals or documented in occupational or epidemiological studies are extrapolated, using mathematical models, to low doses common to environmental exposures. These models are essentially linear at low doses, such that no dose is without some risk of cancer.

#### **8.1.4 Human Health Risk Characterization**

Risk characterization integrates the results of the toxicity and exposure assessments into a quantitative description of potential noncancer and cancer risks. Cancer risks and noncancer health hazards were calculated for the RME and CT exposure conditions for construction worker exposures to soil (surface and subsurface) and future park visitor recreational exposures to surface soil.

##### ***Methodology for Evaluating Noncancer Risks***

The potential for adverse noncancer health effects is characterized by dividing the estimated chemical intakes by the chemical-specific RfDs. The resulting ratio is the hazard quotient (HQ), derived as follows:

$$HQ = \frac{\text{Chemical Intake (mg/kg - day)}}{\text{RfD (mg/kg - day)}}$$

RfD use assumes that there is a level of intake (the RfD) below which it is unlikely that even sensitive individuals (e.g., senior citizens and children), will experience adverse health effects over a lifetime of exposure. If the average daily intake exceeds the RfD (that is, if the HQ exceeds 1), there may be cause for concern regarding noncancer effects.

EPA risk assessment guidelines and WAC 173-340-708(5)(a) consider that adverse effects resulting from simultaneous exposure to two or more chemicals with similar types of toxic response are additive. HQs are summed for chemicals with similar toxic response to arrive at a total hazard index (HI).

### ***Methodology for Evaluating Cancer Risks***

The potential for carcinogenic effects is evaluated by estimating the probability of developing cancer over a lifetime based on exposure assumptions and chemical specific toxicity criteria. The increased likelihood of cancer due to exposure to a particular chemical is defined as the excess cancer risk (i.e., in excess of a background cancer risk of 1 in 100 or  $1 \times 10^{-2}$ ). Excess lifetime cancer risk is estimated by multiplying the estimated chemical intake (i.e., summary intake factor) by the cancer SF, as follows:

$$\text{Cancer Risk} = \text{Chemical Intake (mg/kg-day)} \times \text{SF (mg/kg-day)}^{-1}$$

The risks resulting from exposure to multiple carcinogens are assumed to be additive. The total cancer risk is estimated by summing the estimated risks for each COPC. The EPA's target acceptable excess cancer risk range is  $10^{-6}$  to  $10^{-4}$ , where cancer risks below  $10^{-6}$  are considered acceptable and are not evaluated further, and cancer risks above  $10^{-4}$  are generally considered unacceptable and warrant remedial action. MTCA's target acceptable excess total cancer risk is  $1 \times 10^{-5}$  for sites with multiple carcinogens, where total cancer risks below  $1 \times 10^{-5}$  are considered acceptable as stated in Section 5(a) of WAC 173-340-708.

### ***Results of Risk Characterization***

Risks and hazards to construction workers at the OU D site were evaluated for current and future construction worker exposure to soil and are summarized in Table 8-7. Construction workers could be exposed to soil through incidental ingestion, dermal contact, and inhalation of vapors and dusts. As previously stated, groundwater is not considered a complete exposure pathway because groundwater at BNC is not a potable source. Therefore, it was not evaluated.

The total RME cancer risk and noncancer HI for construction worker exposures to soil were below EPA's and Ecology's target health goals. Total construction worker excess cancer risks were  $6 \times 10^{-7}$ , more than an order of magnitude less than Ecology's target cumulative cancer risk

goal of  $1 \times 10^{-5}$  and below EPA's de minimus risk level of  $1 \times 10^{-6}$ . The majority of the cancer risk is due to benzo(a)pyrene. The total RME construction worker noncancer HI was 0.04, also more than an order of magnitude less than Ecology's and EPA's target HI goal of 1.

The total CT cancer risk and noncancer HI were approximately half of those calculated under RME conditions. The total CT cancer risk was  $3 \times 10^{-7}$  and the total CT noncancer HI was 0.02.

Risks and hazards to park visitors at the OU D site were evaluated for future recreator exposure to soil and are summarized in Table 8-8. Recreators could be exposed to soil through incidental ingestion, dermal contact, and inhalation of dusts.

The total excess RME cancer risk and noncancer HI for recreational visitor exposures to soil were below EPA's and Ecology's target health goals. Total cancer risks were  $1 \times 10^{-6}$ , an order of magnitude less than Ecology's target cumulative cancer risk goal of  $1 \times 10^{-5}$  and equal to EPA's de minimus risk level of  $1 \times 10^{-6}$ . The majority of the cancer risk is due to benzo(a)pyrene (70 percent). The total RME noncancer HI was 0.05 for children, also more than an order of magnitude less than Ecology's and EPA's target HI goal of 1.

The total CT cancer risk and noncancer HI were below EPA's and Ecology's target health goals. The total CT cancer risk was  $6 \times 10^{-8}$  and the total CT noncancer HI was 0.008 for children.

### **8.1.5 Uncertainty Analysis for Human Health Risk Assessment**

Estimating and evaluating health risk from exposure to environmental chemicals is a complex process with inherent uncertainties. Uncertainty reflects limitations in knowledge, and simplifying assumptions must be made in order to quantify health risks.

Uncertainty in the risk assessment produces the potential for two kinds of errors. The first potential, or Type I, error is the identification of a specific chemical, area, or activity as a health concern when, in fact, it is not a concern (false positive conclusion). The second potential, or Type II, error is the elimination of a chemical, area, or activity from further consideration when, in fact, there should be a concern (false negative conclusion). In the risk assessment, uncertainties were handled conservatively (i.e., health-protective choices were preferentially made). This strategy is more likely to produce more false positive errors than false negative errors.

In this assessment, uncertainties relate to (1) the development of media concentrations that people are exposed to, (2) the assumptions about exposure and toxicity, and (3) the characterization of health risks. Uncertainty in the development of media concentrations is due to the inability to sample every square inch of potentially impacted media at a site. Instead, a

limited number of samples must be obtained to represent the contaminant characteristics of a larger medium. The sampling strategies for contaminants in this assessment were, in general, designed to prevent underestimation of media concentrations, thus avoiding an underestimation of the risks to public health.

There are uncertainties regarding the quantification of health risks in terms of a number of assumptions about both exposure and toxicity, including both site-specific and general uncertainties. Based on uncertainty in quantifying exposure and toxicity, the risk assessment is more likely to conclude that health risks and hazards exceed target risk goals when health risks are actually negligible than to conclude that chemicals are not a health risk when they actually are. This process is necessary to ensure the protection of public and ecological health.

Protective assumptions compensate for uncertainties in the calculations or simplifications that might potentially underestimate risk. Potential underestimation of risk is always possible because sampling every square inch of a site is technically infeasible, infrequently detected chemicals are typically screened out during the COPC identification process, toxicity data are often incomplete, simplifying assumptions must be made, and all hypothetically possible conditions and pathways cannot be assessed. Protective assumptions are intended to balance factors that tend to underestimate risk.

## **8.2 ECOLOGICAL RISK ASSESSMENT**

Industrial activity at OU D has led to a site that effectively has no natural habitat. As a result, an ecological risk assessment was not required for OU D. Ecological risks in the nearby marine habitat located south of OU D were evaluated in the OU B RI/FS and further discussed in the OU B M and OU B T RODs.

**Table 8-1**  
**Summary of Chemicals of Potential Concern**

Chemical of Potential Concern	Soil		Groundwater
	0-2 feet bgs	0-15 feet bgs	
Arsenic	X	X	--
Chromium	X	--	--
Mercury	X	--	--
Thallium	X	--	--
Benzo(a)anthracene	X	X	--
Benzo(a)pyrene	X	X	--
Benzo(b)fluoranthene	X	X	--
Dibenz(a,h)anthracene	X	X	--
Indeno(1,2,3-cd)pyrene	X	X	--

Notes:

-- Indicates chemical was not selected as a chemical of potential concern.

bgs- below ground surface

**Table 8-2**  
**Summary of Exposure Point Concentrations**

<b>Chemical</b>	<b>Surface Soil EPC (mg/kg)</b>	<b>All Soil EPC<sup>a</sup> (mg/kg)</b>
Arsenic	3.86	3.70
Chromium	107.25	--
Mercury	0.88	--
Thallium	3.03	--
Benzo(a)anthracene	0.75	0.54
Benzo(a)pyrene	0.81	0.60
Benzo(b)fluoranthene	0.80	0.59
Dibenz(a,h)anthracene	0.09	0.09
Indeno(1,2,3-cd)pyrene	0.38	0.27

<sup>a</sup>These exposure point concentrations (EPCs) were used for both reasonable maximum exposure and central tendency calculations.

Notes:

-- Indicates chemical is not a chemical of potential concern for all soil (construction worker scenario).  
mg/kg - milligram per kilogram

**Table 8-3**  
**Construction Worker Exposures to Soil**  
**Exposure Assumptions and Intake Equations**

<b>Equations:</b> Chemical intake (mg/kg-day) = CS • SIF $SIF_{ing} = \frac{IR \cdot CF \cdot EF \cdot ED}{BW \cdot AT}$ $SIF_{derm} = \frac{CF \cdot SA \cdot AF \cdot ABS \cdot EF \cdot ED}{BW \cdot AT}$ $SIF_{inh} = \frac{InhR \cdot EF \cdot ED \cdot (1/PEF)}{BW \cdot AT}$ <b>Where:</b> SIF <sub>ing</sub> (day-1) = summary intake factor for ingestion of soil SIF <sub>derm</sub> (day-1) = summary intake factor for dermal contact with soil SIF <sub>inh</sub> (day-1) = summary intake factor for inhalation of fugitive dust				
Parameter	Definition	Units	RME Value	CT Value
CS	Chemical concentration in soil	mg/kg	chemical specific	chemical specific
IR	Ingestion rate	mg/day	330	200
CF	Conversion factor	kg/mg	0.000001	0.000001
SA	Surface area	cm <sup>2</sup>	3300	2500
AF	Soil to skin adherence factor	mg/cm <sup>2</sup> -day	0.3	0.1
ABS	Absorption factor	unitless	chemical specific	chemical specific
InhR	Inhalation rate	m <sup>3</sup> /day	20	10
PEF	Particulate emission factor	m <sup>3</sup> /kg	1,320,000,000	1,320,000,000
EF	Exposure frequency	days/year	250	219
ED	Exposure duration	year	1	1
BW	Body weight	kg	70	70
AT <sub>nc</sub>	Averaging time for noncarcinogenic effects	day	ED x 365 days/year	ED x 365 days/year
AT <sub>ca</sub>	Averaging time for carcinogenic effects	day	27,375	27,375

Notes:  
 cm<sup>2</sup> - square centimeter  
 CT - central tendency  
 kg - kilogram  
 m<sup>3</sup> - cubic meter  
 mg - milligram  
 RME - reasonable maximum exposure

**Table 8-4**  
**Park Visitor Recreational Exposures to Soil**  
**Exposure Assumptions and Intake Equations**

<b>Equations:</b>				
Chemical intake (mg/kg-day) = CS • SIF				
$SIF_{ing-nc\ child} = \frac{IRc \bullet CF \bullet EF \bullet EDc}{BWc \bullet ATnc-child}$		$SIF_{ing-nc\ child/adult} = \frac{[(IRc \bullet EDc / BWc) + (IRa \bullet EDa / BWa)] \bullet EF \bullet CF}{ATnc-adult}$		
$SIF_{ing-ca} = \frac{[(IRc \bullet EDc / BWc) + (IRa \bullet EDa / BWa)] \bullet EF \bullet CF}{ATca}$				
$SIF_{derm-nc\ child} = \frac{CF \bullet SAc \bullet AFc \bullet ABS \bullet EF \bullet EDc}{BWc \bullet ATnc-child}$		$SIF_{derm-nc\ child/adult} = \frac{[(SAc \bullet AFc \bullet EDc / BWc) + (SAa \bullet AFa \bullet EDa / BWa)] \bullet ABS \bullet EF \bullet CF}{ATnc-adult}$		
$SIF_{derm-ca} = \frac{[(SAc \bullet AFc \bullet EDc / BWc) + (SAa \bullet AFa \bullet EDa / BWa)] \bullet ABS \bullet EF \bullet CF}{ATca}$				
$SIF_{inh-nc\ child} = \frac{InhRc \bullet ET \bullet EF \bullet EDc}{BWc \bullet ATnc-child}$		$SIF_{inh-nc\ child/adult} = \frac{[(InhRc \bullet EDc / BWc) + (InhRa \bullet EDa / BWa)] \bullet EF \bullet ET}{ATnc-adult}$		
$SIF_{inh-ca} = \frac{[(InhRc \bullet EDc / BWc) + (InhRa \bullet EDa / BWa)] \bullet EF \bullet ET}{ATca}$				
<b>Where:</b>				
SIF <sub>ing-nc</sub> (day <sup>-1</sup> ) = summary intake factor for ingestion of soil-noncarcinogenic effects				
SIF <sub>ing-ca</sub> (day <sup>-1</sup> ) = summary intake factor for ingestion of soil-carcinogenic effects				
SIF <sub>derm-nc</sub> (day <sup>-1</sup> ) = summary intake factor for dermal contact with soil-noncarcinogenic effects				
SIF <sub>derm-ca</sub> (day <sup>-1</sup> ) = summary intake factor for dermal contact with soil-carcinogenic effects				
SIF <sub>inh-nc</sub> (day <sup>-1</sup> ) = summary intake factor for inhalation of soil-noncarcinogenic effects				
SIF <sub>inh-ca</sub> (day <sup>-1</sup> ) = summary intake factor for inhalation of soil-carcinogenic effects				
<b>Parameter</b>	<b>Definition</b>	<b>Unit</b>	<b>RME Value</b>	<b>CT Value</b>
CS	Chemical concentration in soil	mg/kg	chemical specific	chemical specific
IRc	Ingestion rate-child	mg/day	300	120
IRa	Ingestion rate-adult	mg/day	100	50
InhRc	Inhalation rate-child	m <sup>3</sup> /hour	1.2	1.2
InhRa	Inhalation rate-adult	m <sup>3</sup> /hour	1.6	1.6
CF	Conversion factor	kg/mg	0.000001	0.000001
SAc	Surface area-child	cm <sup>2</sup>	2,800	2,800
SAa	Surface area-adult	cm <sup>2</sup>	5,700	5,700
AFc	Soil to skin adherence factor-child	mg/cm <sup>2</sup> -day	0.2	0.04
AFa	Soil to skin adherence factor-adult	mg/cm <sup>2</sup> -day	0.07	0.01
ABS	Absorption factor	unitless	chemical specific	chemical specific
EF	Exposure frequency	days/year	40	20
EDc	Exposure duration-child	years	6	2
EDa	Exposure duration-adult	years	24	7
ET	Exposure time	hours	3	3
BWc	Body weight-child	kg	15	15

**Table 8-4 (Continued)**  
**Park Visitor Recreational Exposures to Soil**  
**Exposure Assumptions and Intake Equations**

Parameter	Definition	Unit	RME Value	CT Value
BW <sub>a</sub>	Body weight-adult	kg	70	70
AT <sub>nc</sub>	Averaging time for noncarcinogenic effects	days	ED x 365 days/year	ED x 365 days/year
AT <sub>ca</sub>	Averaging time for carcinogenic effects	days	27,375	27,375

Notes:

cm<sup>2</sup> - square centimeter

CT - central tendency

-day - per day

kg - kilogram

m<sup>3</sup> - cubic meter

mg - milligram

RME - reasonable maximum exposure

**Table 8-5**  
**Carcinogenic Toxicity Criteria for the Chemicals of Potential Concern**

<b>Chemical</b>	<b>Oral Cancer: Slope Factor (mg/kg-day)<sup>-1</sup></b>	<b>Inhalation Cancer: Slope Factor (mg/kg-day)<sup>-1</sup></b>	<b>Tumor Type</b>	<b>EPA Cancer Classification<sup>a</sup></b>
Arsenic	1.5	15	Leukemia (human)	Group A carcinogen
Benzo(a) anthracene	0.73	0.31	Forestomach, larynx, and esophagus tumors (oral); pharynx, larynx tumors (inhalation)	Group B2 carcinogen
Benzo(a) pyrene	7.3	3.1	Forestomach, larynx, and esophagus tumors (oral); pharynx, larynx tumors (inhalation)	Group B2 carcinogen
Benzo(b) fluoranthene	0.73	0.31	Forestomach, larynx, and esophagus tumors (oral); pharynx, larynx tumors (inhalation)	Group B2 carcinogen
Chromium	none	42	Lung cancer; study assumed 1/6th CrVI	Group A
Dibenzo(a,h) anthracene	7.3	3.1	Forestomach, larynx, and esophagus tumors (oral); pharynx, larynx tumors (inhalation)	Group B2 carcinogen
Indeno(1,2,3- cd)pyrene	0.73	0.31	Forestomach, larynx, and esophagus tumors (oral); pharynx, larynx tumors (inhalation)	Group B2 carcinogen

<sup>a</sup> EPA's Weight-of-Evidence Classification System:

- Group A - human carcinogen (sufficient evidence in humans)
- Group B1 - probable human carcinogen (limited human data available)
- Group B2 - probable human carcinogen (sufficient evidence in animals, inadequate or no evidence in humans)
- Group C - possible human carcinogen (limited evidence in animals)
- Group D - not classifiable as to human carcinogenicity

Notes:

CrVI - chromium in a valence state of plus 6  
 EPA - U.S. Environmental Protection Agency  
 mg/kg-day - milligram per kilogram per day  
 NA – not applicable  
 SF - slope factor

**Table 8-5 (Continued)**  
**Carcinogenic Toxicity Criteria for the Chemicals of Potential Concern**

Sources:

U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS) online database  
<<http://www.epa.gov/iris/index.html>>. March 2003.

U.S. Environmental Protection Agency. *Risk Assessment Issue Paper: Status of Inhalation Cancer Unit Risk for Benzo(a)pyrene*. 95-006. November 1994.

**Table 8-6**  
**Noncancer Toxicity Criteria for the Chemicals of Potential Concern**

<b>Chemical</b>	<b>Oral/Dermal Reference Dose (mg/kg-day)</b>	<b>Inhalation Reference Dose (mg/kg-day)</b>	<b>Toxicity Endpoint</b>	<b>Uncertainty Factor/Level of Confidence</b>
Arsenic	0.0003	None	Hyperpigmentation and hyperkeratosis of the skin	3/Medium confidence
Chromium <sup>a</sup>	0.003	2.6 x 10 <sup>-5</sup>	No endpoint reported for the oral RfD; inhalation RfD endpoint is bronchiole effects in the lung	330/Low confidence (oral and inhalation)
Mercury	0.0003	None	Autoimmune effects	1000/High confidence
Thallium <sup>b</sup>	0.000066	None	No endpoint reported	3000/Low confidence

<sup>a</sup>Chromium toxicity criteria assume 100 percent exposure to CrVI for inhalation RfD.

<sup>b</sup>Thallium's RfD is based on the RfD for thallium sulfate (in EPA's IRIS database) adjusted for plain thallium based on the molecular weight of the thallium in the thallium salt per EPA Region 9 procedures.

Notes:

CrVI - chromium in a valence state of plus 6  
 mg/kg-day - milligram per kilogram per day  
 RfD - reference dose

Source: U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS) online database  
 <<http://www.epa.gov/iris/index.html>>. March 2003.

**Table 8-7**  
**Summary of Risks and Hazards for Construction Worker Exposures to Soil**

	Ingestion		Dermal		Inhalation		Total	
	Hazard	Risk	Hazard	Risk	Hazard	Risk	Hazard	Risk
<b>Reasonable Maximum Exposure</b>								
Arsenic	0.03	2E-07	0.004	2E-08	b	1E-10	0.04	2E-07
Benzo(a)anthracene	a	2E-08	a	7E-09	a	3E-13	a	2E-08
Benzo(a)pyrene	a	2E-07	a	7E-08	a	4E-12	a	3E-07
Benzo(b)fluoranthene	a	2E-08	a	7E-09	a	4E-13	a	3E-08
Dibenz(a,h)anthracene	a	3E-08	a	1E-08	a	5E-13	a	4E-08
Indeno(1,2,3-cd)pyrene	a	8E-09	a	3E-09	a	2E-13	a	1E-08
<b>Total</b>	0.03	4E-07	0.004	1E-07		1E-10	0.04	6E-07
<b>Central Tendency</b>								
Arsenic	0.02	1E-07	0.0008	5E-09	b	5E-11	0.02	1E-07
Benzo(a)anthracene	a	9E-09	a	1E-09	a	1E-13	a	1E-08
Benzo(a)pyrene	a	1E-07	a	2E-08	a	2E-12	a	1E-07
Benzo(b)fluoranthene	a	1E-08	a	2E-09	a	2E-13	a	1E-08
Dibenz(a,h)anthracene	a	1E-08	a	2E-09	a	2E-13	a	2E-08
Indeno(1,2,3-cd)pyrene	a	4E-09	a	7E-10	a	7E-14	a	5E-09
<b>Total</b>	0.02	2E-07	0.0008	3E-08		5E-11	0.02	3E-07

a - This chemical is not associated with noncarcinogenic effects.

b - No inhalation reference dose is available for this chemical to quantify noncancer hazards by the inhalation pathway.

**Table 8-8**  
**Summary of Risks and Hazards for Park Visitor Recreational Exposures to Soil**

	Ingestion			Dermal			Inhalation			Total		
	Child Hazard	Child/Adult Hazard	Child/Adult Risk	Child Hazard	Child/Adult Hazard	Child/Adult Risk	Child Hazard	Child/Adult Hazard	Child/Adult Risk	Child Hazard	Child/Adult Hazard	Child/Adult Risk
<b>Reasonable Maximum Exposure</b>												
Arsenic	0.005	0.001	2E-07	0.002	0.0005	9E-08	b	b	2E-10	0.007	0.002	3E-07
Chromium	0.02	0.005	d	c	c	c	0.00008	0.00004	2E-08	0.02	0.005	2E-08
Mercury	0.001	0.0004	d	c	c	c	b	b	d	0.001	0.0004	
Thallium	0.02	0.005	d	c	c	c	b	b	d	0.02	0.005	
Benzo(a)anthracene	a	a	3E-08	a	a	4E-08	a	a	8E-13	a	a	7E-08
Benzo(a)pyrene	a	a	3E-07	a	a	4E-07	a	a	9E-12	a	a	7E-07
Benzo(b)fluoranthene	a	a	3E-08	a	a	4E-08	a	a	8E-13	a	a	7E-08
Dibenz(ah)anthracene	a	a	3E-08	a	a	5E-08	a	a	1E-12	a	a	8E-08
Indeno(1,2,3-cd)pyrene	a	a	1E-08	a	a	2E-08	a	a	4E-13	a	a	3E-08
<b>TOTAL</b>	0.05	0.01	6E-07	0.002	0.0005	6E-07	0.00008	0.00004	2E-08	0.05	0.01	1E-06
<b>Central Tendency</b>												
Arsenic	0.0009	0.0003	1E-08	0.0002	0.00005	3E-09	b	b	3E-11	0.001	0.0003	2E-08
Chromium	0.003	0.0009	d	c	c	c	0.00004	0.00002	2E-09	0.003	0.001	2E-09
Mercury	0.0003	0.00007	d	c	c	c	b	b	d	0.0003	0.00007	
Thallium	0.004	0.001	d	c	c	c	b	b	d	0.004	0.001	
Benzo(a)anthracene	a	a	2E-09	a	a	1E-09	a	a	1E-13	a	a	3E-09
Benzo(a)pyrene	a	a	2E-08	a	a	1E-08	a	a	1E-12	a	a	3E-08
Benzo(b)fluoranthene	a	a	2E-09	a	a	1E-09	a	a	1E-13	a	a	3E-09
Dibenz(ah)anthracene	a	a	2E-09	a	a	1E-09	a	a	2E-13	a	a	3E-09
Indeno(1,2,3-cd)pyrene	a	a	8E-10	a	a	5E-10	a	a	6E-14	a	a	1E-09
<b>TOTAL</b>	0.01	0.002	4E-08	0.0002	0.00005	2E-08	0.00004	0.00002	2E-09	0.008	0.002	6E-08

- a - This chemical is not associated with noncarcinogenic effects by this pathway.  
 b - No inhalation toxicity criterion is available for this chemical to quantify noncancer hazard/risk by the inhalation pathway.  
 c - No dermal criterion is available for this chemical to quantify dermal exposure.  
 d - This chemical is not associated with carcinogenic effects by this pathway.

## **9.0 REMEDIAL ACTION OBJECTIVES**

This section refers to the originally defined OU D. However, the need for remedial action, the remedial action objectives, and the cleanup levels described in this section apply equally to the newly defined OU D.

### **9.1 NEED FOR REMEDIAL ACTION**

The baseline human health risk assessment for the originally defined OU D concluded that risks to site workers and recreational users are acceptable under current and hypothetical future land use conditions and controls. Levels of contaminants in soil and groundwater would require attention if a change to residential use was contemplated in the future.

EPA guidance (e.g., Role of the Baseline Risk Assessment in Superfund Remedy Selection, OSWER 9355.0-30, April 22, 1991) specifically notes that remedial action may be taken where there is a significant chance of a release occurring that could result in unacceptable risk. Although predicted risks within OU D under current and future hypothetical conditions may not require any action other than institutional controls to ensure protectiveness, potential movement of contaminants off the site remains a matter of concern. Remedial action will minimize the potential movement of contaminants from the soil into the groundwater that eventually flows into Sinclair Inlet. The infiltration from precipitation and a possible future irrigation system, which is typical of public parks, has the potential to leach chemicals from the soil into the groundwater. Contaminated sediments are known to exist in catch basins across BNC, based on experience during cleanup of the stormwater facilities at OU NSC; therefore, the stormwater facilities at OU D also have the potential to transport some contaminated material out of the terrestrial area.

Although the risks from potential soil leaching to groundwater (to surface water) and stormwater system transport of contaminated material have not been explicitly assessed, the human health risk assessment for OU B Marine identified potential long-term risks above acceptable levels to subsistence seafood harvesters consuming bottom-dwelling fish exposed to contaminated sediments. Marine sediment cleanup has been initiated through the OU B Marine ROD and remedial action. However, to prevent potential recontamination, additional action is needed. Thus, contaminants in soil that may leach to groundwater and the contaminants present in the stormwater drainage system are appropriate targets for remedial action at OU D.

## **9.2 REMEDIAL ACTION OBJECTIVES**

Remedial action objectives (RAOs) identified for OU D at Bremerton naval complex are as follows:

- Reduce the potential for chemical transport to the adjacent marine environment from:
  - Accumulation of sediment or debris in the stormwater system
  - Infiltration of soil and groundwater into the stormwater system
  - Infiltration of surface water into the soil
- Continue to limit exposure to site soils and groundwater

## **9.3 CLEANUP LEVELS**

Soil cleanup levels for COCs at OU D are shown in Table 9-1 and are based on MTCA Method B soil values based on surface water protection, except in cases where background concentrations were higher. Cleanup levels for soil were identified to evaluate the alternatives. Presenting the cleanup levels is not meant to imply that the site soil will be cleaned up to those levels, if the selected remedy is considered adequately protective.

No cleanup levels have been established for other site media. The RAOs are based on the need to reduce infiltration of surface water into the soil and prevent contaminated terrestrial media (i.e., accumulated stormwater system sediment and debris, surface water, soil, and groundwater) from being transported to the adjacent marine environment. The RAOs do not identify the need to remediate stormwater system sediment, soil, groundwater, or surface water based on risks due to direct exposure to those media.

**Table 9-1**  
**Cleanup Levels for Soil at OU D**

Chemical of Concern	CAS Number	Cleanup Levels (mg/kg)	Basis
Tetrachloroethene	127-18-4	0.0552	MTCA Method B for protection of surface water <sup>e</sup>
cPAHs (total) <sup>a</sup>	Not applicable <sup>b</sup>	TTEC = 0.866 <sup>c</sup>	MTCA Method B for protection of surface water <sup>e</sup>
4,4-DDT	50-29-3	0.00729	MTCA Method B for protection of surface water <sup>e</sup>
Dieldrin		0.0000672	MTCA Method B for protection of surface water <sup>e</sup>
Endrin	72-20-8	0.00076	MTCA Method B for protection of surface water <sup>e</sup>
Arsenic	7440-38-2	2.64	Area Background <sup>d</sup>
Cadmium	7440-43-9	2.3	Area Background <sup>d</sup>
Copper	7440-50-8	21.7	Area Background <sup>d</sup>
Mercury	7439-97-6	0.06	Area Background <sup>d</sup>
Zinc	7440-66-6	101	MTCA Method B for protection of surface water <sup>e</sup>

<sup>a</sup>Total cPAHs (using total toxicity equivalent concentration [TTEC]).

<sup>b</sup>There is no discrete Chemical Abstract Service number for cPAHs (total).

<sup>c</sup>The preliminary remediation goal for cPAHs (total) in soil requires comparing the TTEC for the seven cPAHs with the MTCA Method B unrestricted soil value for the reference chemical benzo(a)pyrene. The measured chemical concentration for each of the seven cPAHs is multiplied by the TEF to obtain a toxicity equivalent concentration (TEC). The TECs for all the cPAHs are then summed to obtain the TTEC. The TEFs reflect the toxicity of each cPAH relative to benzo(a)pyrene, the reference chemical for mixtures of cPAHs.

<sup>d</sup>Area background was used because the MTCA B value for protection of surface water was lower.

<sup>e</sup>MTCA Method B soil levels protective of surface water were calculated using the equation in Ecology worksheet MTCASGL10.xls.

Notes:

cPAH - carcinogenic polycyclic aromatic hydrocarbon

mg/kg - milligram per kilogram

MTCA - Model Toxics Control Act

RBSC - risk-based screening concentration

TEF - toxicity equivalency factor

TTEC - total toxicity equivalent concentration

## **10.0 DESCRIPTION OF ALTERNATIVES**

The RAOs identified in Section 9 were used to identify a range of technologies for addressing contamination in soil and the sediment in the stormwater drainage system. The technologies were screened to assemble cleanup alternatives for OU D. For both soil and groundwater, the conclusion was that, even for the highest contaminant levels found at OU D, the costs of the most feasible permanent treatment technology were disproportionate to the limited potential benefits. Thus, the four alternatives discussed below do not include active treatment of soil or groundwater. Also, because the four alternatives involve contaminants remaining on site at concentrations that do not allow unlimited site use and unrestricted exposure, a review of the remedy would be required at least every 5 years to comply with CERCLA requirements.

The alternatives are briefly summarized in Table 10-1.

This section describes the alternatives in terms of the originally defined OU D.

### **10.1 ALTERNATIVE 1: NO ACTION**

Alternative 1 is included as required under the NCP to provide a basis for comparing the cost effectiveness of other alternatives. Inclusion of this alternative helps ensure that the consequences of no action are fully evaluated and that instances in which no action may be appropriate are fully recognized so that needless remediation expenses can be avoided when only marginal benefits are expected.

Under this alternative, no proactive measures would be undertaken to remediate concentrations of chemicals, and no institutional controls would be imposed to reduce or prevent human exposure. Concentrations of inorganic materials would remain comparatively constant across the site, but gradual reduction in concentration of organic compounds would occur through natural breakdown processes. This alternative would not include environmental monitoring to assess the effectiveness of natural attenuation or to verify protection of human health or the environment.

### **10.2 ALTERNATIVE 2: MONITORING OF GROUNDWATER WITH LAND USE CONTROLS**

The primary objectives of Alternative 2 are to evaluate the impact of hazardous chemicals present in OU D on the groundwater through monitoring and to limit human exposure to hazardous chemicals through the implementation and maintenance of institutional controls.

Institutional controls are restrictions or administrative requirements placed on activities, access, or exposure to land, groundwater, surface water, or other affected media. Navy land use controls (LUCs) consist of institutional controls and engineering controls. Engineering controls encompass a variety of engineered remedies to contain and/or reduce contamination and physical barriers to limit access to properties.

LUC performance objectives include:

- For the property that may be transferred to the City of Bremerton or made available for use, ensure property use is restricted to recreation, and prohibit the development and use of the property for residential housing, schools, or any land use other than recreational
- Ensure the integrity of the pavement and vegetative cover
- Ensure groundwater is not withdrawn except for monitoring purposes

Alternative 2 includes the following components:

- Land Use Controls
  - Land use restrictions
  - Groundwater use restrictions
  - Maintenance of pavement and vegetative cover
- Environmental Monitoring Components
  - Groundwater monitoring

The individual components of this alternative are discussed below.

### **10.2.1 Land Use Controls**

The Navy is responsible for implementing, maintaining, and reporting on and enforcing land use controls. This may be modified to include another party should the site-specific circumstances warrant it. Although the Navy may transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for remedy integrity. LUCs would apply to OU D as defined on Figure 1-3.

An LUC Remedial Design will be prepared as the land use component of the Remedial Design. Within 90 days of the ROD signature, the Navy shall prepare and submit to the EPA for review and approval an LUC Remedial Design that shall contain implementation and maintenance actions, including periodic inspections.

### ***Land Use Restrictions***

Land use restrictions established under Alternative 2 would conform to current Navy guidance. These restrictions, such as prohibiting the development and use of the property for residential housing on OU D, would be incorporated into any property transfers through a restrictive covenant or easement.

### ***Groundwater Use Restrictions***

Groundwater use would be restricted to monitoring purposes; there is no beneficial use of site groundwater. Groundwater use restrictions would be incorporated into any property transfers through a restrictive covenant or easement.

### ***Maintenance of Asphalt Pavement and Vegetative Cover***

Maintenance of the asphalt paving and vegetative cover would be required to ensure the integrity of those remedial components.

## **10.2.2 Environmental Monitoring Components**

### ***Groundwater Monitoring***

Groundwater monitoring would include periodic sampling and analysis of groundwater for organic and inorganic COCs (Table 9-1) to assess trends in contaminant levels. One monitoring well (LTMP-5), installed as part of the OU B monitoring network, is planned to be used to monitor groundwater from below OU D. This monitoring well would be sampled to measure chemical concentrations in groundwater near the point of discharge to the marine environment. For purposes of cost estimation, it is assumed that one shoreline monitoring well would be sampled annually for 5 years.

## **10.3 ALTERNATIVE 3: CAPPING (VEGETATIVE COVER/ASPHALT PAVING) AND STORMWATER SYSTEM REPAIR WITH MONITORING AND INSTITUTIONAL CONTROLS**

The primary objectives of Alternative 3 are (1) to ensure that risks from human exposure to hazardous chemicals in soil and groundwater remain acceptable in the future through the implementation and maintenance of institutional controls and capping, (2) to reduce the potential of contaminant transport into the stormwater and marine environment through stormwater system cleaning, inspection, and repair program, and (3) to evaluate the impact of chemicals

potentially released to the environment from OU D to the marine environment through monitoring.

Alternative 3 would include the institutional controls and monitoring activities described in Alternative 2, with the exception that periodic stormwater discharge monitoring would not be required. In addition, Alternative 3 would include the following components:

- Installation of a vegetative cover or asphalt concrete pavement over the surface of currently unpaved portions of OU D
- Cleaning and inspection of the stormwater system at OU D, including the repair or replacement (as necessary) of significant structural damage (i.e., collapse or break) in the drain pipes, manholes, and catch basins

After the storm drains are cleaned and repaired, closed-circuit TV will verify that the drains are cleaned and which sections may require repair. Visual inspections of the storm drains will be part of routine maintenance.

Stormwater catch basins and storm drain lines that lie within OU D would be cleaned, inspected, and repaired or replaced as necessary. This component of Alternative 3 would not include the stormwater system outfall (CSO 001), which is beyond the limits of OU D and is included in the remedial activities for OU B.

### **10.3.1 Monitoring and Institutional Control Components**

Alternative 3 would include the same institutional control components and groundwater monitoring components as Alternative 2. However, periodic stormwater discharge monitoring would not be performed.

### **10.3.2 Remedial Construction**

Alternative 3 would also include two remedial construction measures that are described in more detail in the following paragraphs.

#### ***Site-Wide Capping***

A cap consisting of asphalt cement pavement (ACP) has been constructed on the portion of OU D to be retained by the Navy, and existing ACP would be repaired and maintained or replaced with a vegetative cover in the portion of OU D that might be transferred to the City of Bremerton. Should this portion of the property be retained by the Navy, the Navy may elect to

use an ACP cover in lieu of a vegetative cover. The ACP and vegetative covers would reduce surface water infiltration and the potential for transport of contaminants from soil to groundwater. The covers would also reduce surface water infiltration and prevent human exposure to contaminants in the underlying soil and fill. Each element of the site-wide cap would be subject to routine maintenance as necessary to maintain the functionality described above.

In areas that receive a vegetative cover for the selected horizontal barrier, the cover would consist of a nominal thickness of 18 inches of imported loamy soil, tracked in place and overlain by a nominal thickness of 6 inches of topsoil. A geogrid drainage layer would be installed over existing pavement (i.e., existing roadways) that are covered with soil and vegetation to prevent water accumulation on top of the asphalt layer. Water accumulating in the geogrid drainage layer would be directed to a collection trench and piping that would be emptied into a stormwater conveyance system designed to transport water from the area proposed for transfer to the City of Bremerton to the City's stormwater collection system or a new outfall to Sinclair Inlet. Grass plantings would be used to vegetate the cover, with no special landscape plantings or features.

### ***Stormwater System Contaminated Sediment Removal***

Alternative 3 remedial actions for the OU D stormwater system consist of four subcomponents: (1) cleaning and inspecting storm drain lines and catch basins within OU D, (2) repairing or replacing significantly damaged portions of the storm drain system identified during the inspection to prohibit potentially contaminated soil from reentering the system, (3) providing stormwater conveyance systems to handle surface runoff for the new areas of ACP and vegetated cover at OU D (if needed, depending on the final remedial design), and (4) disposal of removed debris and sediment. It is estimated that 20 catch basins, 5 manholes, and an estimated 2,245 lineal feet of storm drain pipeline are present within OU D.

The initial stage of the work on the stormwater system would consist of cleaning contaminated sediment out of the pipelines and catch basins. For this alternative, the initial cleaning and inspection of storm drain lines and catch basins at OU D would be completed as a one-time CERCLA action. Once cleaned and significant damage repaired, the future maintenance of the storm drain components would be conducted as a part of routine maintenance. Removal of sediment and debris would be performed with truck-mounted vacuum units specifically designed for this purpose.

Subsequent to the cleaning, an inspection of the storm drain lines using closed circuit TV inspections would be performed. These inspections would identify sections of the storm drain system that would require repair or replacement.

Significantly damaged storm drain lines that allow soil in will be repaired or replaced. It is anticipated that significant damage would be encountered in about 30 percent of the storm drain lines. Because OU D is isolated in the extreme eastern portion of BNC, repair activities would not materially impact shipyard operation and could be scheduled to minimize disruption in daily shipyard activities.

Additional stormwater collection might be needed to drain runoff from the approximately 2.7 acres of OU D that were previously unpaved and that will be capped with asphalt or vegetative cover under this alternative. The actual need for additional stormwater collection will be determined in the remedial design phase and will depend on the final cover configuration selected. For purposes of alternative comparison, it was assumed that approximately 1,500 linear feet of new stormwater conveyance piping, 5 new manholes, and 20 new catch basins would be added to the system. New stormwater systems in the portion of OU D to be retained by the Navy would be connected to the existing main stormwater discharge line.

Some additional subsurface drainage systems may be needed if existing pavements are not removed and are subsequently covered with a vegetative cap (i.e., the roadway in the southeastern portion of OU D in the area proposed for transfer to the City of Bremerton or old building foundations). In such cases, a geogrid or other drainage collection system could be placed below the vegetated cover to prevent water from ponding on the pavement. Ponding water could create wet, soft conditions at the ground surface that would not be compatible with potential future land use. Water that passes through the geogrid would be directed to collection trenches and into the existing stormwater collection system.

#### **10.4 ALTERNATIVE 4: SOIL REMOVAL/CAPPING (VEGETATIVE COVER/ASPHALT PAVING) AND STORMWATER SYSTEM REPAIR WITH MONITORING AND INSTITUTIONAL CONTROLS**

The primary objectives of Alternative 4 are (1) to limit human exposure to hazardous chemicals through the implementation and maintenance of institutional controls and asphalt paving in areas of OU D retained by the Navy, (2) to reduce the potential of contaminant transport into the marine environment through a stormwater system inspection and repair or replacement program, (3) to reduce the risk of contaminant transport to groundwater through soil removal and replacement (i.e., areas of the property that might be transferred to the City of Bremerton), and (4) to evaluate the impact of chemicals released to the environment from OU D to the marine environment through monitoring.

Alternative 4 would include the activities described in Alternative 3, except that soils exceeding cleanup levels in the eastern portion of the site (which might be transferred to the City of Bremerton) would be removed. An estimated 23,000 cubic yards of soil would be removed from approximately 1.9 acres by excavation and disposed of off-site at an approved facility in accordance with applicable regulations. Clean soil would be imported to replace the soil removed, and the ground surface in this area would be restored with a vegetated (grass) cover.

In areas requiring excavation greater than 5 feet, it is assumed that one catch basin and 140 linear feet of drain piping of the existing stormwater system would be completely removed and replaced. The stormwater from the new drain system was assumed to discharge into the City's existing storm drain system located in the northern end of the property and to be conveyed to the City of Bremerton.

## **10.5 RELATIVE FEASIBILITY AND COST OF ALTERNATIVES**

Table 10-2 summarizes the primary concerns associated with each alternative, as well as changes in the alternatives since the time of the feasibility study. For Alternatives 1 and 2, the concerns involve the remaining potential for human exposure to COCs in soil, the continuing and probable increased potential for COCs in soil to leach into groundwater and migrate to Sinclair Inlet, and the migration of COCs into Sinclair Inlet via the stormwater drainage system. The primary concern associated with Alternative 3 is that COCs in soil are contained and not removed. The primary concern of Alternative 4 is the high cost and the complexity of a large soil removal and replacement action.

Table 10-3 summarizes the costs for each of the alternatives, with a discount rate of 7 percent used to calculate the present-worth cost over periods of 5 and 40 years. Total present worth for the 40-year period ranges from \$15,000 to \$6,542,000. The minimum costs are associated with the No Action alternative. The capital cost associated with the No Action alternative is for project management and the evaluation and documentation of the alternative.

**Table 10-1**  
**Summary of Alternatives**

<b>Alternative</b>	<b>Description</b>
1. No Action	<ul style="list-style-type: none"> <li>Federal guidelines require that the No Action alternative be included as an alternative.</li> </ul>
2. Monitoring With Institutional Controls	<ul style="list-style-type: none"> <li>Establish land use controls, such as prohibiting development of residential housing, schools, or any other land use other than recreational; restricting groundwater use; and maintaining the integrity of the pavement and vegetative cover</li> <li>Monitor groundwater</li> </ul>
3. Capping (Vegetative Cover/Asphalt Paving) and Stormwater System Repair With Monitoring and Institutional Controls	<ul style="list-style-type: none"> <li>Establish same institutional controls as Alternative 2</li> <li>Monitor groundwater same as Alternative 2</li> <li>Implement program to clean, inspect, and repair or replace the stormwater system as necessary</li> <li>Upgrade and repair pavement, install new pavement, and construct a vegetative cover</li> </ul>
4. Soil Removal/Capping (Vegetative Cover/Asphalt Paving) and Stormwater System Repair With Monitoring and Institutional Controls	<ul style="list-style-type: none"> <li>Establish same institutional controls as Alternative 2</li> <li>Excavate and dispose of 23,000 cubic yards of soil to remove contaminants above cleanup levels</li> <li>Monitor groundwater same as Alternative 2</li> <li>Implement program to clean, inspect, and repair or replace the stormwater system as necessary</li> <li>Upgrade and repair pavement, install new pavement, and construct a vegetative cover</li> </ul>

**Table 10-2**  
**Summary of Feasibility of Alternatives**

<b>Alternative</b>	<b>Primary Concerns</b>	<b>Primary Modifications Since Feasibility Study</b>
1. No Action	<ul style="list-style-type: none"> <li>Contaminated soil would remain as is, allowing the potential for COCs to leach from the soil and migrate to the inlet.</li> <li>Material remaining in stormwater drainage system and unrepaired significant damage to the system have the potential to transport COCs to Sinclair Inlet.</li> </ul>	None
2. Monitoring With Institutional Controls	<ul style="list-style-type: none"> <li>Contaminated soil would remain as is, allowing the potential for COCs to leach from the soil and migrate to Sinclair Inlet.</li> <li>Material remaining in stormwater drainage system and unrepaired significant damage to the system have the potential to transport COCs to Sinclair Inlet.</li> </ul>	None
3. Capping (Vegetative Cover/Asphalt Paving) and Stormwater System Repair With Monitoring and Institutional Controls	<ul style="list-style-type: none"> <li>Contaminated soil would be contained and not removed.</li> </ul>	None
4. Soil Removal/Capping (Vegetative Cover/Asphalt Paving) and Stormwater System Repair With Monitoring and Institutional Controls	<ul style="list-style-type: none"> <li>Alternative is costly and more complex to implement.</li> </ul>	None

Note:  
 COC - chemical of concern

**Table 10-3**  
**Summary of Alternative Costs**

<b>Alternative</b>	<b>Capital Cost</b>	<b>Annual O&amp;M<sup>a</sup></b>	<b>Total Present Worth, 5 Years<sup>b</sup></b>	<b>Total Present Worth, 40 Years<sup>b</sup></b>
1. No Action	\$15,000	\$0	\$15,000	\$15,000
2. Monitoring With Institutional Controls	\$87,000	\$39,000	\$245,000	\$601,000
3. Capping (Vegetative Cover/Asphalt Paving) and Stormwater System Repair With Monitoring and Institutional Controls	\$1,912,000	\$90,000	\$2,278,000	\$3,103,000
4. Soil Removal/Capping (Vegetative Cover/Asphalt Paving) and Stormwater System Repair With Monitoring and Institutional Controls	\$5,335,000	\$90,000	\$5,706,000	\$6,542,000

<sup>a</sup> For Alternative 2, annual O&M costs include IC monitoring, an excavation management plan, groundwater and storm drain monitoring, technical data management, annual report, and project management. For Alternatives 3 and 4, O&M costs include the same elements in Alternative 2,` minus storm drain monitoring plus inspection of the ACP and vegetative cover and pavement and vegetative cover repair.

<sup>b</sup> Present-worth costs are in year 2003 dollars computed using a discount rate of 7 percent.

## **11.0 COMPARATIVE ANALYSIS OF ALTERNATIVES**

Through promulgation of the National Contingency Plan, 40 CFR 300.430, the EPA has developed the following nine criteria for the detailed evaluation of remedial alternatives:

- Overall protection of human health and the environment;
- Compliance with regulations;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability;
- Cost;
- State acceptance; and
- Community acceptance.

These criteria address CERCLA requirements as well as related technical and policy considerations important in selecting remedial procedures. The first two criteria serve as threshold criteria that must be met by an alternative prior to selection. In addition to serving as the basis for detailed analyses conducted during the FS process, the nine criteria provide the framework by which a remedial action alternative is selected.

Each of the evaluation criteria is described in detail in EPA guidance. An overview of each criterion is included in the following discussion of the comparative analysis. Table 11-1 briefly summarizes the conclusions of the comparative analysis. Based on the evaluations in the following subsections, a rating from poor to very good was assigned to each evaluation criterion.

This section evaluates the alternatives in Section 10 that were based on the originally defined OU D.

### **11.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT**

The criterion of overall protection of human health and the environment addresses whether an alternative would provide adequate protection of human health and the environment and how risks posed through each exposure pathway would be eliminated, reduced, or controlled, through treatment, engineered controls, or institutional controls.

The CERCLA risk assessment for OU D demonstrated that human health risks are within acceptable limits under potential recreational and construction worker scenarios. Risks would be higher for a residential scenario. OU D poses a threat to the marine environment from potential transport of contaminants present at the site.

Alternative 1, the No Action alternative, does not include any actions to control potential transport of contaminants to the marine environment. Thus, Alternative 1 is not fully protective of the environment and meets this threshold criterion the least.

Alternative 2, Institutional Controls and Monitoring, would be effective at protecting human health within OU D. Institutional controls would continue to limit the potential for contact with chemicals present at the site. Although this alternative does not include any measures to control potential transport of contaminants to the marine environment, the results of groundwater monitoring could be used to evaluate whether COCs are reaching groundwater and the marine environment of Sinclair Inlet. If actual or potential adverse impacts are found, then measures to control those impacts could be considered as future actions.

Given the protectiveness established through restrictions on future development and institutional controls, subsurface soils would be of concern only to future construction workers who may be exposed to COCs in fill or soil for extended periods at the site. Alternative 3 would provide greater protection than Alternative 2 by improving and maintaining existing asphalt or concrete paving and adding asphalt or vegetative cover to unpaved areas. This would reduce the potential for exposure to contaminants in groundwater by further reducing the potential for COCs to migrate from soil into groundwater. Also, cleaning and restoration of the stormwater facilities would address a primary mechanism for potentially transporting contaminants to the marine environment. Alternative 4 includes removal of a large portion of the soils that exceed MTCA Method B criteria for the protection of surface water on the portion of OU D that might have a future recreational use. This would be incrementally more protective and reduce contaminant migration by removing soil containing COCs. Alternative 4 offers more protection than the other alternatives.

Alternatives 3 and 4 would be more protective than Alternative 2 because they would implement cleaning, inspection, and repair or replacement of the stormwater system. Alternative 4 would be incrementally more protective than Alternative 3 because it includes removal of contaminated soil, which could otherwise pose some risk of contributing to groundwater contamination via infiltration through the vegetative cover and leaching processes. Under Alternative 3 paved areas reduce infiltration and divert stormwater away from the contaminated soil beneath the pavement. Infiltration may increase in vegetated areas in Alternative 3 due to potential future land use (i.e., watering of vegetation in a recreational park scenario).

In summary, the ranking for the alternatives for overall protection of human health and the environment is:

- Alternative 1—least protective (poor)
- Alternative 2—moderately protective (fair)
- Alternative 3—highly protective (good)
- Alternative 4—most protective (very good)

## 11.2 COMPLIANCE WITH ARARS

Section 121(d) of CERCLA and NCP 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations, which are collectively referred to as “ARARs,” unless such ARARs are waived under CERCLA section 121(d)(4).

*Applicable requirements* are those cleanup standards, standards of control, or other substantive requirements, criteria, or limitations promulgated under Federal environmental, State environmental, or facility-siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a State in a timely manner and that are more stringent than Federal requirements may be applicable. *Relevant and appropriate requirements* are those cleanup standards, standards of control, or other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility-siting laws that, while not “applicable” to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those State standards that are identified by a State in a timely manner and that are more stringent than Federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether the remedy will meet all of the applicable or relevant and appropriate requirements of other State and Federal environmental statutes or provides a basis for invoking a waiver.

Alternative 1 does not comply with ARARs. Chemicals in site soil exceed MTCA Method B levels, which are based on unrestricted land use and the protection of surface water. Alternative 1 does not include any actions to control potential transport of contaminants to the marine environment and human exposure to contaminants at the site. Therefore, Alternative 1 does not

comply with ARARs. This Alternative is eliminated from further consideration and is not included in the following sections discussing the remaining evaluation criteria.

Alternative 2 complies with ARARs. Alternative 2 would limit, but not prevent, exposure to soil. Alternatives 3 and 4 would comply with all identified ARARs by including active measures to reduce COC migration from the soil into Sinclair Inlet and reduce potential contact with soil contaminants and by employing institutional controls to prevent exposure to groundwater and establish compliance monitoring. No ARARs waivers are being invoked.

In summary, the alternatives that comply with the ARARs are ranked from worst to best, demonstrating the ARARs preference for contaminant reduction and permanent solutions:

- Alternative 1—does not comply with ARARs (poor)
- Alternative 2—complies with ARARs (fair)
- Alternative 3—complies with ARARs and is preferable to Alternative 2 due to inclusion of active measures to reduce contaminant migration to Sinclair Inlet and control potential contact with contaminants; while COCs continue to be present, the remedial actions are as compliant with ARARs as the remedial actions of Alternative 4 (very good).
- Alternative 4—complies with ARARs and is a more permanent solution due to soil removal, which reduces the volume of contamination (very good)

### **11.3 LONG-TERM EFFECTIVENESS AND PERMANENCE**

The criterion of long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time. This criterion includes the consideration of residual risk that will remain on site following remediation and the adequacy and reliability of controls.

Alternative 2 offers some level of long-term effectiveness and permanence through institutional controls. Alternatives 3 and 4 are considered protective of human health for the long term. Also, Alternatives 3 and 4 are more protective of the environment because they address storm drain contaminants. Therefore, Alternatives 3 and 4 would provide long-term effectiveness for human health and the environment, and Alternative 2 would not.

In summary, the alternatives rank as follows from worst to best on long-term effectiveness and permanence:

- Alternative 2—moderately compliant (fair)
- Alternative 3—highly effective and permanent (good)
- Alternative 4—most effective and permanent due to greater degree of removal of contaminants from site (very good)

#### **11.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT**

The criterion of reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

None of the alternatives would include actual treatment as a component of the remedy.

#### **11.5 SHORT-TERM EFFECTIVENESS**

The criterion of short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction of the remedy. Alternatives involving more complex construction are inherently more risky to workers and the community.

For short-term effectiveness to workers and the community, Alternative 2 does not involve significant contact with the soil and groundwater, as actions are limited to monitoring well installation and sampling activities. Since Alternative 4 involves significant potential worker contact with contaminated soil during excavation, this alternative is rated less effective than Alternative 3. Alternative 3 has less direct contact with chemicals in soil and groundwater than Alternative 4, but workers are exposed to chemicals in the stormwater system in both Alternatives 3 and 4. Thus, Alternative 2 has the greatest short-term effectiveness, followed by Alternatives 3 and 4.

For short-term effectiveness of environmental impacts, Alternative 4, which includes capping, soil removal, and stormwater facility restoration work, is considered the most effective alternative, because these actions restrict or reduce potential migration of COCs from the soil into Sinclair Inlet (via leaching and groundwater transport, or stormwater transport) immediately

upon completion of construction. Alternative 3 would provide similar environmental benefits from capping only. Alternative 2 would provide a means to protect the community from contact with contaminants.

Alternatives 3 and 4 would result in short-term impacts on the environment during implementation. Both include the increased construction activity related to capping and to cleaning, inspection, and repair/replacement of the stormwater system. Alternative 4 also includes the additional impacts of soil removal.

The alternatives rank as follows, from worst to best, on short-term effectiveness:

- Alternative 2—least potential impacts to construction workers and the community (good), but less effective in reducing environmental impacts of COCs (fair)
- Alternative 3—potential impacts to construction workers and the community with less construction worker exposure (fair), while environmental benefits are comparable to Alternative 4 (good)
- Alternative 4—significant potential impacts to construction workers and the community during removal actions (poor); the environmental benefits of Alternative 4 are comparable to or better than Alternative 3 (very good)

## **11.6 IMPLEMENTABILITY**

The criterion of implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered. Increased amounts of construction and greater complexity decrease the implementability of an alternative.

In general, all four alternatives would be readily implementable because they involve comparable maintenance of institutional controls, periodic environmental monitoring, and proven construction techniques. Generally, the more construction activity that is included in an alternative, the more difficult that alternative would be to implement.

The alternatives rank as follows from worst to best on implementability:

- Alternative 4—implementation expected to be quite challenging (poor)

- Alternative 3—implementation expected to be less challenging than Alternative 4 (fair)
- Alternative 2—most readily implemented (good)

## 11.7 COST

Order-of-magnitude cost estimating for remedial alternatives typically achieves an accuracy of +50 to -30 percent for a specified scope of actions. Because of contaminated soil and groundwater left in place, Alternatives 2, 3, and 4 would all require maintenance and monitoring into the foreseeable future. The present worth of capital, operation and maintenance, and periodic costs were evaluated based on 5- and 40-year periods at an annual discount rate of 7 percent. Costs are based on 2003 dollars. The estimated costs of the alternatives are summarized in Table 11-1.

Table 11-1 shows that the cost of implementing Alternative 2 is significantly less than Alternatives 3 or 4. The costs for Alternatives 3 and 4 are significantly higher (an order of magnitude higher) because of the construction required for these alternatives. The estimated cost for Alternative 4 is more than twice the estimated cost of Alternative 3, primarily because Alternative 4 includes significant soil removal and disposal.

In terms of present worth, the alternatives rank as follows, from worst to best:

- Alternative 4—greatest projected construction cost. The operation, maintenance, and periodic review costs of Alternative 4 are comparable to those of Alternative 3.
- Alternative 3—construction costs projected to be less than half of Alternative 4, but significantly more than Alternative 2. Operation, maintenance, and periodic review costs of Alternative 3 are comparable to those of Alternative 4.
- Alternative 2—lowest cost

## 11.8 STATE ACCEPTANCE

The Washington State Department of Ecology supports Alternative 3.

## **11.9 COMMUNITY ACCEPTANCE**

The RAB has been involved in the review and comment process for all project documents leading to this ROD. On August 11, 2004, the Navy held an open house and public meeting to discuss the proposed plan for final action for OU D. The public comment period extended from July 26, 2004, to August 25, 2004.

**Table 11-1**  
**Comparison of Cleanup Alternatives to Criteria**

<b>Criterion</b>	<b>Alternative 1 No Action</b>	<b>Alternative 2 Monitoring With Institutional Controls</b>	<b>Alternative 3 Capping (Vegetative Cover/ Asphalt Paving) and Stormwater System Repair With Monitoring and Institutional Controls</b>	<b>Alternative 4 Soil Removal/Capping (Vegetative Cover/Asphalt Paving) and Stormwater System Repair With Monitoring and Institutional Controls</b>
Overall protection of human health and the environment	Poor—not protective of the marine environment	Fair	Good	Very good
Compliance with regulations	Poor—would not meet state or federal regulations	Fair	Very good	Very good
Long-term effectiveness and permanence	Poor—not protective of human health	Fair	Good	Very good
Reduction of toxicity, mobility, or volume through treatment	N/A	N/A	N/A	N/A
Short-term effectiveness (for community and workers)	Very good	Good	Fair	Poor
Short-term effectiveness (for environment)	Very good	Very good	Good	Fair
Implementability	Very good	Good	Fair	Poor
Cost <sup>a</sup>	\$15,000/\$15,000	\$245,000/\$600,000	\$2,300,000/\$3,100,000	\$5,700,000/\$6,500,000

<sup>a</sup> Present-worth costs for periods of 5 and 40 years.

N/A - Not Applicable

## **12.0 THE SELECTED REMEDY**

This section applies to the currently defined OU D.

### **12.1 SUMMARY OF THE RATIONALE FOR THE SELECTED REMEDY**

Alternative 3 is the Selected Remedy for OU D. Alternative 3 is protective of human health and the environment and provides the best overall balance of risk reduction and cost effectiveness. Some of the key factors in the selection of Alternative 3 include the following:

- Alternative 3 is more protective of human health and the environment than Alternatives 1 or 2, because it minimizes the potential for migration of COCs in the soil to Sinclair Inlet and involves cleaning and inspecting the storm drain system and repairing significantly damaged storm drain lines.
- Alternative 3 complies with ARARs.
- Alternative 3 gets a good rating on long-term effectiveness and permanence. The paving and vegetative cover is expected to remain permanently, with institutional controls in place.
- The paved surfaces and vegetative cap will reduce infiltration from precipitation and the mobility of the COCs in soil.
- Cleaning and inspecting the storm drain system and repairing significantly damaged storm drain lines will reduce the potential transport of contaminants to the marine environment via the storm drain system.
- Alternative 3 provides comparable benefits for significantly less cost when compared to Alternative 4.

### **12.2 DESCRIPTION OF THE SELECTED REMEDY**

The following subsections summarize the components of the Selected Remedy.

### **12.2.1 Site-Wide Capping**

The vegetative cap will be installed on portions of OU D if the proposed land transfer is completed. If the Navy retains ownership of OU D, the Navy may either pave the area with ACP or install a vegetative cap. Future replacement of ACP with vegetative cap, and visa versa, consistent with land use at the site, is acceptable.

Areas designated for either ACP or vegetative cover would be designed and constructed to minimize contact with human and ecological receptors and reduce infiltration of rain or irrigation waters into the underlying substrate.

For cost estimating purposes, some basic construction details were assumed as described in this paragraph. A 4-inch asphalt layer was assumed for existing pavement in need of repair, and a 4-inch asphalt layer over a 6-inch base was assumed for areas that are presently uncapped. In areas that receive a vegetative cover for the selected horizontal barrier, the cover will consist of 18 inches of imported loamy soil, tracked in place and overlain by 6 inches of topsoil. A geogrid drainage layer will be installed over existing pavement (i.e., existing roadways) that are covered with soil and vegetation to prevent water accumulation on top of the asphalt layer. Water accumulating in the geogrid drainage layer will be directed to a collection trench and piping that will be emptied into a stormwater conveyance system designed to transport water from the area proposed for transfer to the City of Bremerton to the City's stormwater collection system or a new outfall to Sinclair Inlet. Grass plantings will be used to vegetate the cover, with no special landscape plantings or features. Actual construction details will be provided in the remedial design.

The appropriateness of applying seal coating to existing site pavement to further reduce infiltration will be evaluated during the preparation of the remedial design. For cost estimating purposes, it is assumed that the seal coat will be applied to both the existing good pavement and the new pavement that will be placed in the presently unpaved or poorly paved areas. In planning and designing pavement upgrades, particular attention will be given to areas around storm drain inlets.

Site-wide capping will help meet the RAOs. Placement of an asphalt cap and vegetation over the contaminated soil will limit infiltration/percolation of stormwater to the groundwater and thereby "reduce the potential for chemical transport to the adjacent marine environment." Site-wide capping will also isolate contaminated soils and "limit exposure to site soils and groundwater" through human contact.

### **12.2.2 Stormwater System Contaminated Sediment Removal**

Alternative 3 remedial actions for the OU D stormwater system consist of the following subcomponents: (1) cleaning and inspecting storm drain lines and catch basins within OU D, (2) repairing or replacing significantly damaged portions of the storm drain system to prohibit potentially contaminated soil from reentering the system, and (3) disposal of removed debris and sediment. As described in Section 10, additional stormwater conveyance systems may be needed to handle surface runoff for the new areas of ACP and vegetative cover at OU D, depending on the final remedial design. Stormwater system inspection, repair, and replacement will help meet the RAO to “reduce the potential for chemical transport to the adjacent marine environment.”

From maps of BNC storm drain lines, it was estimated that 10 catch basins and an estimated 500 lineal feet of storm drain pipeline are present within OU D. Figure 12-1 shows the locations of storm drain lines that will be cleaned and inspected under Alternative 3. For cost estimating purposes in the FS, it was assumed that approximately 30 percent of these storm drain lines will require repair.

#### ***Cleaning and Inspection of Storm Drain Lines***

Cleaning and inspection of storm drain lines and catch basins at OU D will be completed as a CERCLA action. Once cleaned, the future maintenance of the storm drain components will be conducted as a part of routine maintenance related to NPDES compliance activities.

Accumulations of soil, fill, and miscellaneous debris that may clog some of the storm drain lines at OU D will be removed from the lines and disposed of appropriately. Subsequent to the cleaning, an inspection of the storm drain lines will be performed. These inspections will identify sections of the storm drain system that will require repair or replacement.

Precautions will be taken to minimize the potential for discharge of debris to Sinclair Inlet during the cleaning operation. Removal of soil, fill, and debris from the storm drain system will substantially reduce the potential for contaminants to be transported to Sinclair Inlet, either as suspended material or dissolved in storm runoff. Repair or replacement of broken piping will reduce the potential for introduction of contaminated soil into the storm drain system, where it could be transported into the marine environment.

Soil, sediment, or miscellaneous debris removed from the storm drain lines and catch basins under this alternative will be managed in compliance with applicable regulations.

### ***Repair of Storm Drain Lines***

Storm drain lines will be repaired in areas identified during camera inspection activities. It is assumed that isolated sections requiring repair will be excavated and replaced with new pipe. In a similar storm drain cleaning effort at OU NSC, a large number of broken or damaged lines were encountered and there were some conflicts of repairs with daily industrial operations. It is anticipated that damage will be encountered in about 30 percent of the storm drain lines. However, since OU D is isolated in the extreme eastern portion of the shipyard, it was assumed that such repair activities can be scheduled to minimize disruption in daily shipyard activities.

### **12.2.3 Institutional Controls**

Institutional controls (ICs) are an important component of the Selected Remedy. The IC objectives for OU D are as follows:

- For the property that may be transferred to the City of Bremerton or made available for use, ensure property use is restricted to recreation, and prohibit the development and use of the property for residential housing, schools, or any land use other than recreational
- Ensure the integrity of the pavement and vegetative cover
- Ensure groundwater is not withdrawn except for monitoring purposes

The Navy will be responsible for developing an LUC Remedial Design during the remedial design process documenting the nature of the institutional controls applicable to the site. The LUC Remedial Design will identify measures to assess the effectiveness of these controls. The remedial design will define the specific implementation actions necessary to achieve these IC objectives. The ICs will be in effect for OU D, as defined in Figure 1-3, and will be maintained until concentrations of hazardous substances in the soil and groundwater are at such levels to allow for unrestricted use and exposure.

The institutional controls will help meet the RAO to “limit exposure to site soils and groundwater.”

The Navy will notify EPA and Ecology at least six (6) months prior to any transfer, sale or lease of any property subject to ICs so that EPA and the state can be involved in discussions to ensure that appropriate provisions are included in the conveyance documents to maintain effective ICs. In advance of a transfer of ownership or control of the property, the Navy shall take action within the limitations of their authority to ensure that the controls and restrictions identified in the

remedial design will continue after the transfer and any successive transfers pursuant to agreement among the Navy, EPA and Ecology. If it is not possible for the facility to notify EPA and Ecology at least six months prior to any transfer, sale or lease, then the facility will notify EPA and Ecology as soon as possible but no later than 60 days prior to the transfer, sale or lease of any property subject to ICs.

#### **12.2.4 Groundwater Monitoring**

The objective of monitoring the groundwater is to verify that the remedy is effective in minimizing the migration of COCs into Sinclair Inlet via the groundwater pathway through monitoring. There is no current or expected future beneficial use of groundwater at OU D. Groundwater monitoring will be conducted in conjunction with the groundwater monitoring for OU B T. One monitoring well (point of compliance well LTMP-5, installed as part of the OU B monitoring) was installed in 2004 and will be used to monitor groundwater from below OU D. This well will serve as the conditional point of compliance for groundwater. This monitoring well will be sampled to measure chemical concentrations of COCs in groundwater near the point of discharge to the marine environment.

The Navy, EPA, and Ecology selected constituents for groundwater monitoring based on a review of the COCs identified for soil at OU D. For any given analyte, the appropriate compliance criterion will be the more stringent of the State and Federal surface water or marine water standards unless local background values already exceed these standards. In cases where the local background values exceed these levels or criteria, the appropriate standards will be based on the local background values. Table 12-1 lists the constituents to be monitored in groundwater and the conditional point of compliance groundwater criteria.

Details regarding groundwater monitoring locations, sampling requirements, and sampling frequencies will be defined during the development of a long-term monitoring plan for OU D or as an amendment to the long-term monitoring plan for OU B T. After at least four rounds of annual monitoring, the Navy, in conjunction with EPA and Ecology, will evaluate the results of the groundwater monitoring and make appropriate revisions to the monitoring program. Such revision could include termination of groundwater monitoring, if it is agreed that the monitoring is no longer providing useful information. Analysis will be discontinued for any contaminant not detected above its monitoring criteria (Table 12-1) in a given well after four consecutive sampling events spanning the last 2 years of monitoring.

The Navy, in conjunction with EPA and Ecology, may make additional revisions to the monitoring plan based on periodic reviews and optimization studies.

Groundwater monitoring will provide information to verify predictions that site groundwater is protective of the marine environment as it relates to the RAO to “reduce the potential for chemical transport to the adjacent marine environment.”

### **12.3 SUMMARY OF EXPECTED REMEDY COST**

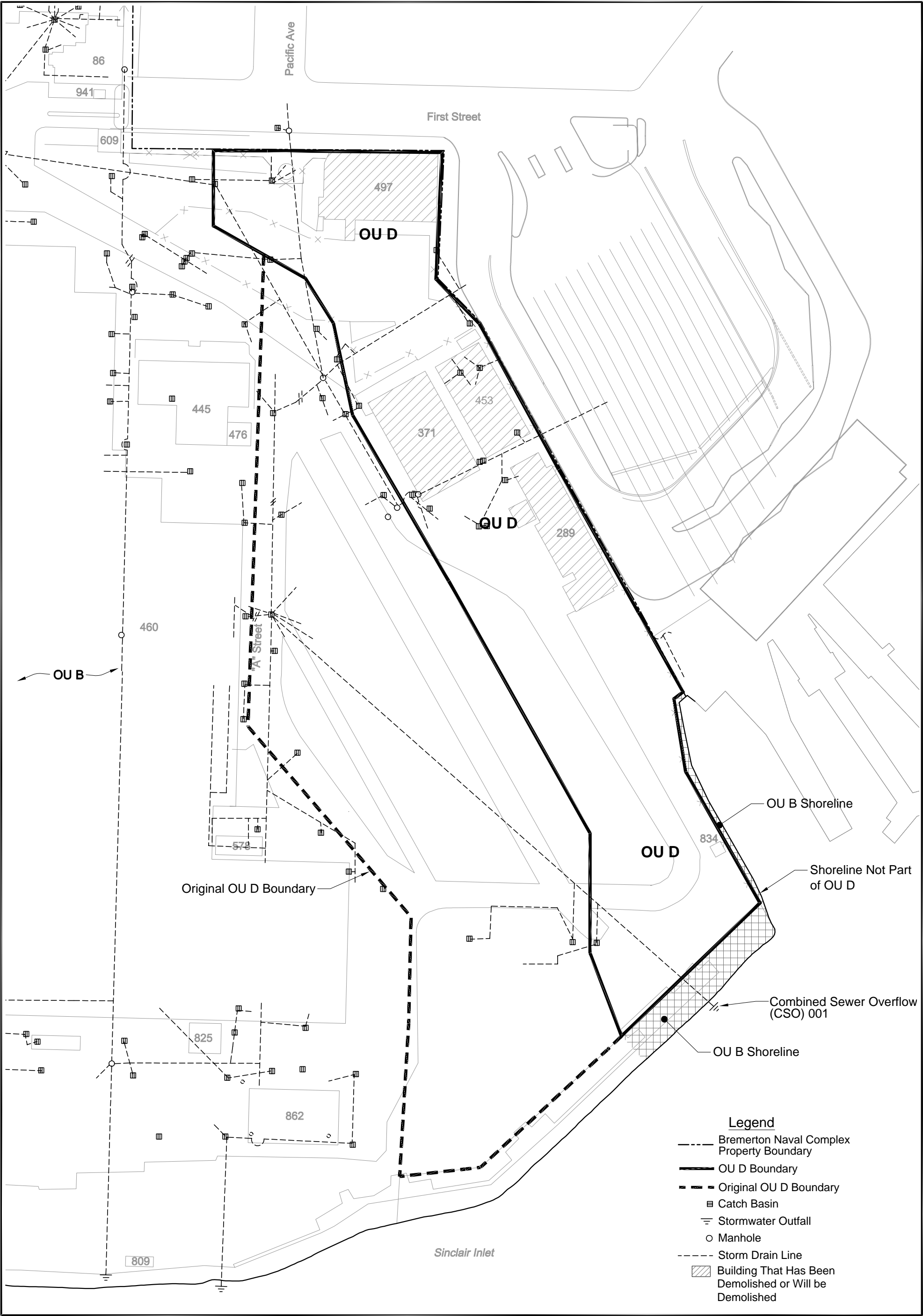
The projected costs associated with the Selected Remedy are summarized in Table 12-2 in terms of year 2003 dollars. The information in this is based on the best information available at the time of preparation of the final OU D feasibility study. Changes in cost components can be expected as a result of new information collected during remedial design. This is an order-of-magnitude engineering cost estimate, expected to be within +50 to –30 percent of the actual project cost.

### **12.4 EXPECTED OUTCOMES OF THE SELECTED REMEDY**

The Selected Remedy is compatible with current industrial land use and potential future recreational land use. Institutional controls are expected to be sufficient to ensure the protectiveness of post-remedy conditions at the site. The contaminants that will be left in place at the site will be effectively contained by the combination of pavement and vegetative cover.

The Selected Remedy will have no impact on current or potential future groundwater use at the BNC or in the vicinity. As noted in Section 7.1, groundwater within OU D is not a current source of drinking water and is expected to remain unsuitable for domestic use for the foreseeable future.

The Selected Remedy is expected to minimize the potential for migration of COCs to Sinclair Inlet through the stormwater drainage system, reduce the potential for the COCs in soil to migrate to the groundwater and eventually to Sinclair Inlet in excess of marine/surface water criteria, and reduce human contact with contaminated soil. Paving and vegetative cover will reduce the limited potential that presently exists for contaminants to be transported to Sinclair Inlet by precipitation infiltrating the soil and leaching chemicals to the groundwater and for human contact with contaminants.



**Table 12-1**  
**Groundwater Monitoring Criteria at OU D**  
**for Protection of Surface Water**

Chemical of Concern	CAS Number	Regulatory Level (µg/L)	Basis	Practical Quantitation Limit (µg/L)	Preliminary Remediation Goal (µg/L) <sup>a</sup>
4,4-DDT	50-29-3	0.000356	MTCA Method B	0.01	0.01
Dieldrin	60-57-1	0.0000867	MTCA Method B	0.01	0.01
Endrin	72-20-8	0.0023	State/federal WQC	0.01	0.01
Arsenic	7440-38-2	5.0	Area Background <sup>b</sup> (MTCA Method B)	0.5	5.0
Cadmium	7440-43-9	8.8	State/federal WQC	1	8.8
Copper	7440-50-8	2.4	National Toxics Rule	0.5	3.1
Mercury	7439-97-6	0.025	State/federal WQC	0.2	0.2
Zinc	7440-66-6	81	State/federal WQC	1.8	81

<sup>a</sup> A groundwater monitoring standard is established as the higher of the regulatory level or the practical quantitation limit and is based on protection of adjacent surface waters of Sinclair Inlet.

<sup>b</sup> The background value for arsenic in groundwater (5.0 µg/L) is used because the lowest stringent applicable or relevant and appropriate requirement (ARAR) value is less than the area background value. This area background was established in the OU B RI report.

Notes:

CAS - Chemical Abstract Service

cPAHs - carcinogenic polycyclic aromatic hydrocarbons

µg/L - microgram per liter

MTCA - Model Toxics Control Act

PCBs - polychlorinated biphenyls

PCE - tetrachloroethene

TCE - trichloroethene

WQC - water quality criteria

**Table 12-2**  
**Summary of Estimated Remedy Cost (Newly Defined OU D)**

Description	Cost	Source
<b>DIRECT CAPITAL COSTS</b>		
1. Asphalt Paving/Vegetative Cover - eastern portion of OU D <sup>a,b</sup>	\$292,903	EE, FD
2. Stormwater Inspection and Repair <sup>c</sup>	\$341,794	EE, FD
<b>TOTAL DIRECT CAPITAL COSTS</b> (Rounded to nearest \$1,000)	\$635,000	
<b>INDIRECT CAPITAL COSTS</b>		
1. Indirect Costs for Institutional Controls and Monitoring	\$67,623	EE
2. Asphalt Paving/Vegetative Cover - eastern portion of OU D <sup>a,b</sup>	\$173,560	EE
3. Stormwater Inspection and Repair	\$119,260	EE
Five-Year Review	\$20,000	FD
Project Management (5% of DCC)	\$31,750	EE
Mobilization, bond, insurance (5% of DCC)	\$31,750	-
Engineering/Construction Management Support (5% of DCC)	\$31,750	-
<b>TOTAL INDIRECT CAPITAL COSTS</b> (Rounded to nearest \$1,000)	\$476,000	-
Capital/Indirect Contingency (20% DCC and ICC)	\$222,200	-
<b>INDIRECT CAPITAL COSTS (Continued)</b>		
<b>TOTAL CAPITAL COSTS</b> (Rounded to nearest \$1,000)	<b>\$1,333,000</b>	-
<b>ANNUAL O&amp;M</b>		
1. Annual O&M Costs for Institutional Controls and Monitoring from Alternative 2 (Reduced \$7,000 for Elimination of Storm Drain Discharge Sampling)	\$31,570	EE
2. Asphalt Paving/Vegetative Cover	\$42,888	EE, FD
Subtotal	\$74,458	-
O&M Contingency (20%)	\$14,892	-
Total Annual O&M	\$89,350	-
<b>PRESENT-WORTH ANNUAL O&amp;M (5 years, 7%)</b>	<b>\$366,353</b>	-
<b>PRESENT-WORTH ANNUAL O&amp;M (40 years, 7%)</b>	<b>\$1,191,188</b>	-
<b>Total Present-Worth Costs (5 Years)</b>	<b>\$1,699,353<sup>d,e</sup></b>	
<b>Total Present-Worth Costs (40 Years)</b>	<b>\$2,524,188<sup>d,e</sup></b>	

<sup>a</sup>Assumes design is 6-inch base with 4-inch asphalt concrete (3" binder/1" wearing course). Area to be paved

**Table 12-2 (Continued)**  
**Summary of Estimated Remedy Cost (Newly Defined OU D**

includes unpaved areas and damaged existing pavement (estimated as percent of existing paved areas).  
Exact areas to be paved will be defined during remedial design and/or start of remedial action.

<sup>b</sup>Vegetative cover includes an 18" loam soil fill, 6" topsoil, and hydroseeding with an athletic field mix (no landscaping). The cover design also includes a Geogrid-type constructed drainage layer to reduce infiltration and provide drainage to existing and new stormwater control systems at OU D (only over existing paved road under cap). Exact areas that will have vegetative cover will be defined during remedial design and/or start of remedial action.

<sup>c</sup>Capital costs have been calculated for an initial cleaning and inspection of the storm drain system but not for operation and maintenance.

<sup>d</sup>These costs differ from estimated costs in Section 10, because the originally defined OU D area included a greater area. The cost for the remedy for the western portion of the formally defined OU D will be borne under OU B T. The cost estimates in Section 12 are specific to the currently defined OU D area.

<sup>e</sup>This estimate is subject to change based on future land use planning.

Notes:

BNC - Bremerton naval complex

DCC - direct capital costs

EE - engineer's estimate

FD - former design

ICC - indirect capital costs

OU D - Operable Unit D

O&M - Operation and Maintenance

## 13.0 STATUTORY DETERMINATIONS

### 13.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The Selected Remedy will protect human health and the environment by reducing the potential for contaminated sediments to be transported to Sinclair Inlet from OU D, reducing the potential for leaching of contaminants from soil to groundwater, and reducing the potential for contact with contaminated soil.

### 13.2 COMPLIANCE WITH ARARS

The Selected Remedy will comply with Federal and State ARARs. *Applicable requirements* address the specific circumstances existing at a CERCLA site. *Relevant and appropriate requirements* address circumstances similar enough to those existing at the site to be considered well-suited to the site. Background information on the ARARs can be found in the FS. No ARAR waivers are being invoked at this time. ARARs for the remedy are discussed below.

**Clean Water Act Section 303—Federal Ambient Water Quality, 71 FR 18935-18936 (November 27, 2002).** Section 304(a)(1) of the Clean Water Act requires EPA to develop, publish, and revise criteria for water quality accurately reflecting the latest scientific knowledge. These revised criteria are relevant and appropriate to point-source discharges to surface water that may be established as part of the selected remedial action, i.e., during stormwater system cleaning, inspection, and repair/replacement, and these are relevant and appropriate to groundwater discharges to surface water. These values are relevant and appropriate for the selected remedy because they represent the latest scientific knowledge and because these criteria were developed to better protect aquatic organisms such as those that may be found within Sinclair Inlet [see CERCLA Section 121(d)(2)(B)(i)]. The Selected Remedy will satisfy this ARAR by ensuring that discharges established by the remedy do not cause exceedances of the water quality criteria in receiving surface waters.

**Washington Water Quality Standards for Surface Waters (Ch. 173-201A WAC).**

Washington's toxics standards for protection of marine aquatic life (Section 070), as submitted to EPA by May 30, 2000, and any changes adopted by Washington and approved by EPA between May 30, 2000, and the date of this ROD are applicable to discharges to surface water in Washington state (with the exception of tribal lands). These regulations are applicable to the Selected Remedy to the extent the Selected Remedy results in a discharge to surface water in Washington state, i.e., during stormwater system cleaning, inspection, and repair/replacement.

The Washington state regulations for human health protection incorporate the National Toxics Rule (40 CFR 131.36) by reference.

**Washington Clean Water Act Stormwater General Permit for Construction Activities (Ch. 173-226 WAC).** These regulations provide for issuance of permits to discharge stormwater from construction activities. Although a permit would not be required for implementing an on-site remedy, substantive requirements of the Construction Stormwater General Permit prepared by the Washington State Department of Ecology would be applicable to elements of the selected remedy that result in discharges of stormwater, including excavating and replacing stormwater lines and paving ground surfaces. The general permit provides for use of sediment and erosion controls and other stormwater management measures.

**Shoreline Management Act Regulations (Ch. 173-27 WAC).** The shoreline management regulations are applicable to construction of the shoreline protection remedy, which requires work in the area extending landward 200 feet from the ordinary high-water mark. Federal agency actions within a coastal county must be consistent to the maximum extent practicable with the approved Washington state coastal zone management program and with the local master program.

**Toxic Substances Control Act (15 USC 2601 et seq.).** TSCA is applicable to the collection and disposal of materials containing PCBs and asbestos.

**Washington Hazardous Waste Management Act Regulations (Ch. 173-303 WAC) and Resource Conservation and Recovery Act (RCRA) Subtitle C Regulations (40 CFR Parts 261 and 268).** These regulations are applicable to the identification and disposal of wastes that will be moved outside the area of contamination and are designated as dangerous (including federally hazardous) wastes because they exhibit the toxicity characteristic.

**Washington Solid Waste Management Act Regulations (Ch. 173-350 WAC).** These regulations are applicable to the management and disposal of waste materials that are not Washington dangerous wastes. They provide minimum functional standards for solid waste handling.

**Washington State Model Toxics Control Act Regulations (WAC 173-340).** Chapter 173-340-360(3)(e) of MTCA is applicable to the demonstration that treatment of groundwater or soil would be disproportionately costly given site conditions; 173-340-440 is applicable to the institutional controls included in the remedy; 173-340-720(8)(c) is applicable to making use of a conditional groundwater point of compliance; 173-340-745 is applicable to the development of remedies for soil at an industrial site; 173-340-740 is applicable to the development of remedies

for soil at a recreational/residential site; and 173-340-730 is applicable for developing soil cleanup levels based on the protection of surface water

**Native American Graves Protection and Repatriation Act (NAGPRA) Regulations (43 CFR Part 10).** NAGPRA regulations are intended to protect Native American graves from desecration through the removal and trafficking of human remains and “cultural items” including funerary and sacred objects. These regulations are applicable to ground disturbing activities such as stormwater system work that could uncover Native American burials and cultural items. If such items were to be inadvertently discovered during excavation, the excavation would be required to cease and any affiliated tribes (the Suquamish, for example) would be notified and consulted.

**National Historic Preservation Act (NHPA) Regulations (36 CFR Parts 60, 63, and 800).** NHPA regulations require federal agencies to consider the possible effects of their activities on historic sites or structures (generally older than 50 years) that may be on or eligible for the National Register of Historic Places. These regulations are applicable to any activities conducted under the remedy that could affect the PSNS Historic District or yet to be discovered sites or features in other areas of OU D. If the Navy were to find a potential adverse affect on historic sites or structures, it would be required to evaluate alternatives to “avoid, minimize, or mitigate” the impact, in consultation with the State Historic Preservation Officer (SHPO). Unavoidable impacts on historic sites or structures may be mitigated through such means as taking photographs and collecting historical records.

### **13.3 COST-EFFECTIVENESS**

Alternative 3, the Selected Remedy, is cost-effective and represents a reasonable value for the money that will be spent. In making this determination, the following definition was used: “A remedy shall be cost-effective if its costs are proportional to its overall effectiveness” (40 CFR 33.430(f)(1)(ii)(D)). This was accomplished by evaluating the overall effectiveness of the alternatives that satisfied the threshold criteria (i.e., the Selected Remedy and Alternatives 2 and 4 were both protective of human health and the environment and were ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness.

The estimated present-worth cost of the Selected Remedy is approximately \$3,103,000, projected over a 40-year period. Alternative 2 would be substantially less costly at a projected cost of \$600,000. However, while Alternative 2 is more effective than the Selected Remedy in the short

term, it is substantially inferior in terms of long-term effectiveness and permanence and in terms of reduction in toxicity, mobility, or volume as compared to the Selected Remedy and Alternative 4.

Alternative 4 has a projected cost of approximately \$6,500,000, which is significantly more than the Selected Remedy. Alternative 4 is more effective than the Selected Remedy in terms of long-term effectiveness and permanence. However, the Selected Remedy has a good rating for that comparison criterion and has a higher rating for short-term effectiveness. None of the alternatives would include actions that would achieve reduction in toxicity, mobility, or volume through treatment. However, the Selected Remedy and Alternative 4 are effective in terms of reducing potential mobility of contaminants left in place.

The overall effectiveness of Alternative 3 was determined to be proportional to its costs, and, hence, the Selected Remedy represents a reasonable value for the cost.

#### **13.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE**

The Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at the site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the Selected Remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, short-term effectiveness, implementability, cost, and reductions in toxicity, mobility, or volume achieved through treatment.

The Selected Remedy meets the statutory requirement to use permanent solutions to the maximum extent practicable. Long-term effectiveness is achieved by the Selected Remedy through removal and appropriate disposal of source materials from within the stormwater system, reduction of potential contaminant mobility, and containment of contaminants left on site.

#### **13.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT**

The Selected Remedy does not include treatment that reduces the toxicity, mobility, or volume of waste. Treatment was not found to be practicable for contaminated materials at OU D.

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (40 CFR 300.430(a)(1)(iii)(A)). Principal threat wastes are source materials considered highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur.

The contaminated materials present at OU D that are addressed by this ROD are not considered to be principal threat wastes. They are not highly toxic or highly mobile, and they can reliably be contained. Because no principal threat wastes are present at OU D, the Selected Remedy satisfies EPA's expectation that treatment should be used to address the principal threats posed by a site wherever practicable.

EPA has also established an expectation for use of engineering controls, such as containment, for waste that poses a relatively low, long-term threat or where treatment is impracticable (40 CFR 300.430(a)(1)(iii)(B)). The Selected Remedy is consistent with this expectation.

### **13.6 FIVE-YEAR REVIEW REQUIREMENTS**

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of remedial action to ensure that the remedy is protective of human health and the environment.

## **14.0 DOCUMENTATION OF SIGNIFICANT CHANGES**

The Proposed Plan for OU D was published for public comment in June 2004. The plan identified Alternative 3 as the preferred alternative. The only significant change to Alternative 3 since the publication of the Proposed Plan and the public meeting held August 11, 2004, is the revision to the western boundary of OU D as described in Section 1.

## 15.0 RESPONSIVENESS SUMMARY

These comments and responses refer to the originally defined OU D as presented during the Public Meeting. Since the Public Meeting, the western boundary of OU D was redefined, and OU D was reduced in size.

Summary of oral comments received at the Public Meeting:

1. The proposed cost was presented for Alternative 3. Do you have a relative cost for Alternative 4?

Response: The estimated cost for Alternative 4 is \$5,700,000 to \$6,500,000, which is almost twice as much as Alternative 3. The excavation and disposal of 23,000 cubic yards of soil in Alternative 4 account for the much of the additional estimated cost. The Navy and regulatory agencies do not believe that the additional cost justifies the minimal improvement in public health and the environment.

2. Did the study include the ramifications resulting from the relocation of Building 50 to the park, such as disturbing the soil?

Response: The evaluation of OU D did not address the relocation of Building 50, because the purpose of this study is to evaluate site contaminants and evaluate ways to limit exposure of these contaminants to people and the environment. When a foundation for Building 50 is built, soils will be disturbed. Because the relocation of Building 50 is not a CERCLA issue, there will be a separate plan that addresses its relocation and related impacts.

3. Is there ongoing monitoring associated with the proposed Alternative 3, and who is responsible for monitoring the portion of land that may be transferred to the City? How long will monitoring last?

Response: Alternative 3 includes groundwater monitoring. One monitoring well will likely be installed on the Navy side of OU D located downgradient of the City and Navy portions of OU D. A sample collected from this well will represent water that has migrated from the city portion of OU D and traveled beneath the Navy-retained portion of OU D, which will be redesignated as OU B T after an Explanation of Significant Differences specifies the boundary between OU D and OU B T. The well is expected to be monitored annually for the first 5 years

after the restoration is implemented. Then data would be reviewed, and subsequent monitoring requirements would be determined at that time.

4. Could you clarify as to whether the shoreline is being considered as part of the transfer to the City?

Response: The shoreline is considered as part of the land that may be transferred to the City.

5. Is the Navy going to maintain its shoreline and the erosion protection that was done along that portion of the property that may get transferred to the City?

Response: When the Navy transfers a CERCLA site, the deed of transfer requires the new property owner to monitor and upkeep requirements. The ultimate responsibility for the remedy remains with the Navy because the Navy was the creator of the contamination. Shoreline erosion protection was accomplished under the remedy for OU B T.

6. Under Alternative 3, there appears to be no future monitoring proposed for stormwater.

Response: There is no stormwater monitoring as part of Alternative 3 because the Navy would remove contaminants from the stormwater system and repair or replace any damaged parts of the system.

7. In the event of an earthquake or ground shifting, how would the integrity of the stormwater system be checked?

Response: As part of standard maintenance, a manual inspection of the stormwater system would ensure that the stormwater system is still intact. The Navy would monitor sediment accumulation in catch basins. If there is sediment accumulating from a damaged system, then the Navy would investigate and repair the system if necessary.

8. Does the Navy pay for the cleanup before the property is to be transferred, or is there a proposal for sharing the cost of the remediation with the potential new owners of the land?

Response: The Navy will pay for and complete the remediation before the property is transferred.

Summary of written comments received from the public during the comment period:

9. There could be a problem with the City of Bremerton maintaining the transferred property. The City of Bremerton poorly manages the property they are responsible for now.

Response: The City would have to agree to maintain the institutional controls (excavation restrictions, prohibit the use of groundwater, etc.) in the land transfer agreements. The Navy would maintain the ultimate responsibility for the remedy.

10. Alternative 4 is the best choice for the safety of the community. Money should not be a factor in this case.

Response: After evaluating all alternatives in detail, the Navy and regulatory agencies agree that Alternative 3 meets the cleanup objectives. It eliminates the exposure pathway to people who may use the proposed park and is overall protective of people and the environment.

11. Will any of the proposed cleanup occur near Haven E Road in Jackson Park Navy Housing? My son is an asthmatic with a terrible reaction to soil.

Response: The proposed cleanup is related to the southeast corner of Puget Sound Naval Shipyard and Intermediate Maintenance Facility in Bremerton only and not near the Jackson Park Navy Housing.